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PERFORMANCE CHARACTERISTICS OF 5- AND 6-FOOT COMBINES[1]

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DEVELOPMENT OF SMALL COMBINES

The spread in the use of the combine has been eastward since it first became established as a practicable means of harvesting grain on the Pacific coast. To meet crop and field conditions encountered, changes in size and design of the machines have been made. In the early stages of development, machines cutting a 15- to 35-foot swath were needed primarily for wheat, whereas in later years, smaller machines for harvesting and threshing a variety of crops have been in demand. While the larger machines will handle the crops the initial investment is too high for use on the relatively small Corn and Winter Wheat Belt farms.

To meet the needs of small farms, combines in a wide variety of sizes including 7-, 8-, 9-, 10-, and 12-foot cuts were placed on the market. The 7-foot size and some of the others were designed for operation from the power takeoff of a tractor. One 8-foot machine was attached to and supported by a tractor. Some 10-foot and all larger sizes used an engine mounted on the combine for operating moving parts.

The combine is the most satisfactory machine yet devised for harvesting soybeans, the acreage of which has increased greatly in recent years in the Corn Belt. The use of pneumatic tires on tractors and field machinery greatly reduced the rolling resistance of such equipment, making available a greater portion of the power developed by the tractor engine for useful work. Thus the combination of rubber

[1] Based on studies conducted in cooperation with the Agricultural Engineering Departments of the University of Illinois, Purdue University, and Ohio Agricultural Experiment Station, the Mississippi Agricultural Experiment Station, and the Bureau of Agricultural Economics. For assistance in field work and analysis of grain and soybean samples, the authors wish to thank A. L. Young and Paul Bateman, University of Illinois; I. D. Mayer, Purdue University; G. W. McCuen and E. A. Silver, Ohio State University; Frank Caperton and J. O. Smith, Mississippi Agricultural Experiment Station; H. P. Prue and J. E. Barr, Bureau of Agricultural Economics; Thayer Cleaver and George Stafford, Bureau of Agricultural Engineering.

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tires and the demand for combines in the Corn Belt for soybean harvesting stimulated the development of the present 5- and 6-foot power takeoff machines which can be operated by a two-plow tractor under average conditions.

SCOPE OF STUDY AND PROCEDURE

Power take-off combines mounted on rubber tires and cutting a 5- or 6-foot swath were offered to the trade for the first time in the United States in 1935. In a few cases machines were sold at an earlier date primarily for observation under farm operating conditions. During 1935 and 1936 probably 10,000 of these machines were manufactured and the greater portion of them were sold in the Corn and Winter Wheat Belts. Work was begun in 1935 and continued in 1936 by the Bureau of Agricultural Engineering and the agricultural engineering departments of several State colleges in making field observations and tests of these machines in harvesting small grain and soybeans. Tests were made on 5- and 6-foot combines in harvesting small grain near Urbana, Ill., Lafayette, Ind., and Columbus, Ohio, and in soybeans near Urbana, and in the Mississippi Delta in the vicinity of Greenville, Miss., and Tallulah, La. Large machines, operating under practically the same crop, field, and weather conditions as the small ones, were used as a basis for determining the effectiveness of the newer type small machine.[3]

An attempt was made to include all available makes of 5- and 6-foot combines in this study and larger ones were tested as found operating regardless of type, size, and make. Some experimental machines of the small sizes which had not been offered to the trade were also tested.

In making these tests an effort was made to determine the performance characteristics of the machines as operated by farmers. Unless there was something obviously wrong no adjustments were made before a combine was tested. If the results of a test showed high threshing or cutter-bar loss or poor quality grain, the operator was informed and recommendations made as to adjustments. When adjustments were made tests were usually repeated to determine what, if any, improvements in performance resulted.

The procedure in making field tests differed somewhat in the various States but the object in each case was to determine the performance characteristics of the 5- and 6-foot machines in comparison with larger machines of conventional design. For making a comparison, tests were made to determine how much of the unthreshed and threshed crop was thrown out with the straw and chaff, how much missed by the cutter bar, the rate of travel, the width of cut, and the quality of the crop obtained with the various types and sizes of machines.

For harvesting small grain in Ohio the length of the cutter bar was taken as the width of swath as the operator of the combine was requested to take a full swath during the test. An area the width of cut of the machine under test and long enough to equal one one-hundredth of an acre was staked off. An area of twice this size was

[3] REYNOLDSON, L. A., KIFER, R. S., MARTIN, J. H., and HUMPHRIES, W. R. THE COMBINED HARVESTER-THRESHER IN THE GREAT PLAINS. U. S. Dept. Agr. Tech. Bull. 70, 61 pp., illus. 1928.
——— HUMPHRIES, W. R., and MARTIN, J. H. HARVESTING SMALL GRAIN, SOYBEANS, AND CLOVER IN THE CORN BELT WITH COMBINES AND BINDERS. U. S. Dept. Agr. Tech. Bull. 244, 55 pp., illus. 1931.
HURST, W. M., and HUMPHRIES, W. R. HARVESTING WITH COMBINES. U. S. Dept. Agr. Farmers' Bull. 1761, 36 pp., illus. 1936.

used to test some of the large machines. Two tarpaulins were used, one for the straw ejected by the straw rack, or walkers, and one for the chaff ejected by the lower shoe. This material was kept separate and the quantity of threshed and unthreshed grain from each source determined. The straw and chaff were also weighed in the Ohio tests. As the combine crossed the starting line, so to speak, the tarpaulins were placed to catch the straw and chaff, a bucket or sack was placed under the grain spout, and the time noted. As the machine crossed the finish line the tarpaulins were swung to one side, the container for collecting grain removed, and the time noted.

In other States where tests were made, three or more stakes were set parallel to and at equal distance from the line of uncut grain where the crop was drilled or broadcast and only one tarpaulin used to catch the straw and chaff. As the machine came along the tarpaulin was held to catch the straw and chaff and at the same time a container was placed under the grain spout and the time noted.

The area harvested during each test in States other than Ohio depended somewhat upon the width of swath cut and the condition of the crop but was usually more than one one-hundredth of an acre. When the signal was given to end the test the tarpaulin was dropped, the container used for catching the threshed grain removed from the grain spout, and the time noted. The width of the swath was determined by measuring from the stakes to the line of uncut grain. The distance the machine traveled while under test was also measured. After making a test the straw was separated from the chaff with forks and piled to one side on the tarpaulin. The straw was rethreshed with a double cylinder bean thresher or stationary thresher either in the field where the test was made or at a central location and the grain or beans cleaned with a fanning mill and weighed. The chaff was also put through the thresher and the grain cleaned and weighed.

No thresher was available for threshing the straw collected in testing combines in harvesting soybeans in the Mississippi Delta, so the straw was threshed by hand. In fields where the soybeans were planted in rows the number of rows taken per swath and the row width were noted and the equivalent width of swath determined. In other respects the procedure in making tests in the South was the same as in Indiana and Illinois.

To measure cutter-bar losses, all grain heads or pods including shattered seed were picked up from five 1-square-yard areas selected at random on the strip cut during the test. This material was threshed, usually by hand, cleaned with a fanning mill, and the grain weighed. Shattering before harvest was not evident except in a few fields of soybeans in Illinois and Mississippi during the 1935 season and most fields in Illinois during the 1936 soybean season. In fields where shattering was apparent the shattered beans usually were picked up from five square-yard areas in the unharvested portion of the field adjacent to the test area. This preharvest loss was deducted from the total loss picked up after the machine in order to obtain the net loss chargeable to the machine.

After a test was made the threshed grain caught before reaching the grain bin or sacking attachment was weighed and sampled for grade determinations. These samples were placed in airtight grain moisture cans and mailed to a laboratory of the Bureau of Agricultural Economics for physical analysis. Samples of small grains were sent to

the Toledo, Ohio, Federal grain supervision office and soybean samples to the Washington, D. C., soybean standardization and inspection office. When two or more tests were made on a combine in the same field it was not customary to obtain samples for each test unless adjustments made on the machine were likely to alter the quality of the grain. It was customary in several States, particularly Illinois, to make two or more tests in each field, even if the combine was performing in a satisfactory manner, to eliminate possible errors due to crop or field conditions.

In reviewing results obtained with the 5- and 6-foot machines in comparison with those of larger sizes it is well to keep in mind that practically all of the small ones were new, in no case more than 2 years old. Some of the 8-foot and larger machines were badly worn but usually were in the hands of experienced operators. The lack of experience on the part of some operators of small combines was offset in part by factory or local service men who adjusted the machines in the field and gave helpful suggestions as to operation.

A comparison of the performance characteristics of large and small machines is based largely on grain losses and quality of grain obtained. Studies were also restricted to rather small areas in the several States although the areas are typical of the regions involved, such as the Corn Belt and the Mississippi Delta.

Any new model of a farm machine is likely to require alterations and changes in design by the manufacturer over a period of several years following its introduction. Such items as first cost, overhead costs, operating costs, and acreage handled annually must be considered by a prospective user. For these reasons the descriptions and illustration of several small machines should not be construed as a recommendation by the Department of Agriculture as to size or type of machine best suited to a particular locality.

DESCRIPTION OF MACHINES

Some of the 5- and 6-foot machines are similar in design to the larger ones while others embody radical departures from conventional design. They are all similar, however, in that pneumatic tires are used and the threshing and cleaning capacity is generally larger per foot of cutter-bar width than in other machines, making possible a higher ground speed.

In one of the small machines an angle-bar cylinder is used and in others the spike-tooth or rasp-bar type. Figure 1 shows a 5-foot combine in which the cut crop is conveyed upward and rearward to an angle-bar cylinder which extends the full width of cut. The angle-iron bars on the cylinder are faced with rubber and rubber concaves are used. The concaves, blocks of rubber held in place by clips, are parallel to and extend the full length of the cylinder. The separator is set at right angles to the direction of travel and the straw is ejected at the side of the machine. The threshed grain is conveyed to a grain bin from which it may be unloaded by an elevator to a wagon or truck.

Figure 2 illustrates a 6-foot combine in which the cut crop is conveyed upward and rearward and deposited on a conveyor for feeding to an overshot spike-tooth cylinder. The separator on the machine is also at right angles to the direction of travel and the straw is ejected

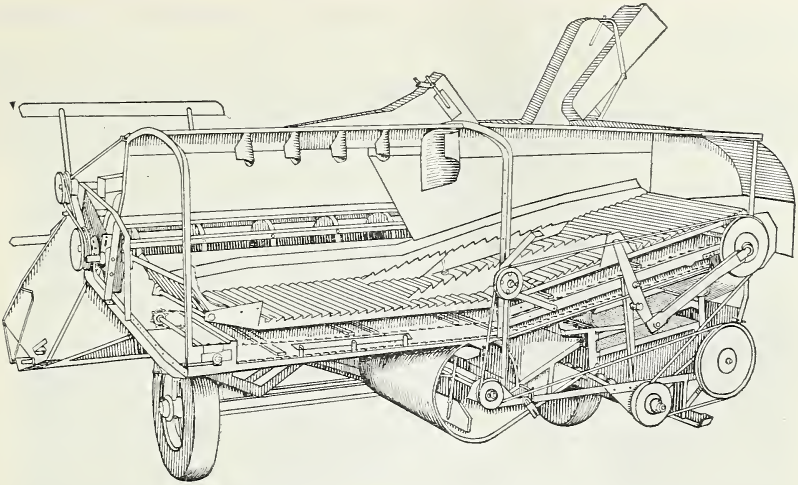

FIGURE 1.—A 5-foot power take-off combine with angle-bar cylinder.

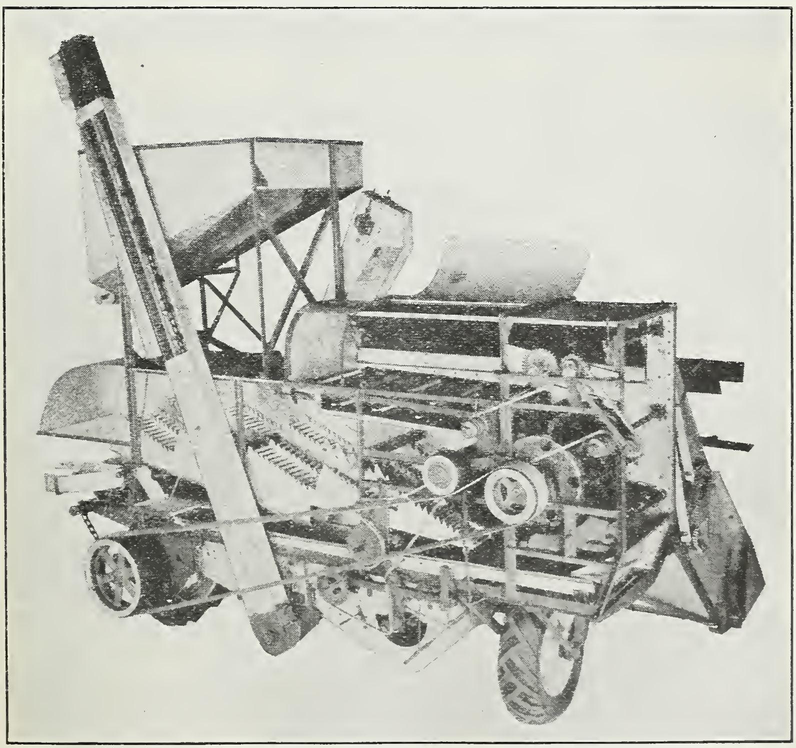

FIGURE 2.—A 6-foot power take-off combine with overshot spike-tooth cylinder.

at the side. The threshed grain is conveyed to a grain bin for emptying by gravity.

A machine with 6-foot cut of somewhat more conventional design is shown in figure 3. The cut crop is conveyed to one side at right angles to the direction of travel and deposited in a feeder house from where it is fed to a rasp-bar cylinder. The straw moves rearward

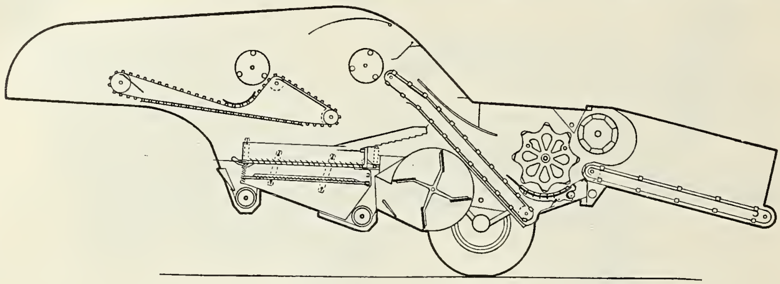

FIGURE 3.—A 6-foot power take-off combine with rasp-bar cylinder.

from the cylinder into the separator and is deposited at the rear of the machine. A grain bin is used for unloading by gravity.

Figure 4 shows a 5-foot combine in which the threshing and separating units are similar to those on machines of conventional design. The header differs from such machines, however, in that the cutter bar extends across the front end of the combine. This design permits a

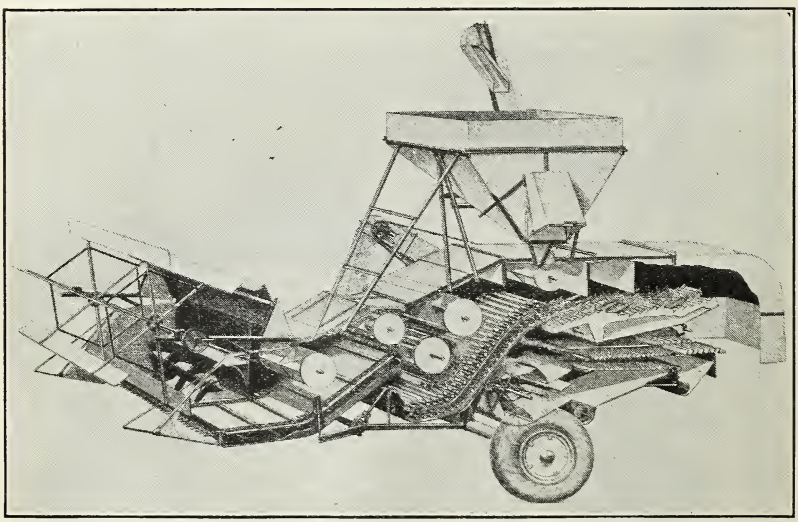

FIGURE 4.—A 5-foot power take-off combine equipped with rasp-bar cylinder and having a portion of the header in front of the feeder-house conveyor.

part of the cut crop to fall on the feeder-house conveyor and move directly to the cylinder. A spiral conveyor moves the cut crop to the feeder house from the rest of the header.

To meet demands in certain areas 5- and 6-foot combines may be equipped with sacking attachments (fig. 5). In figure 6 is illustrated a power take-off combine with grain bin for emptying by gravity,

and figure 7, one in which the bin is emptied by an elevator. Provisions are also made on some makes of 6-foot combines for mounting an

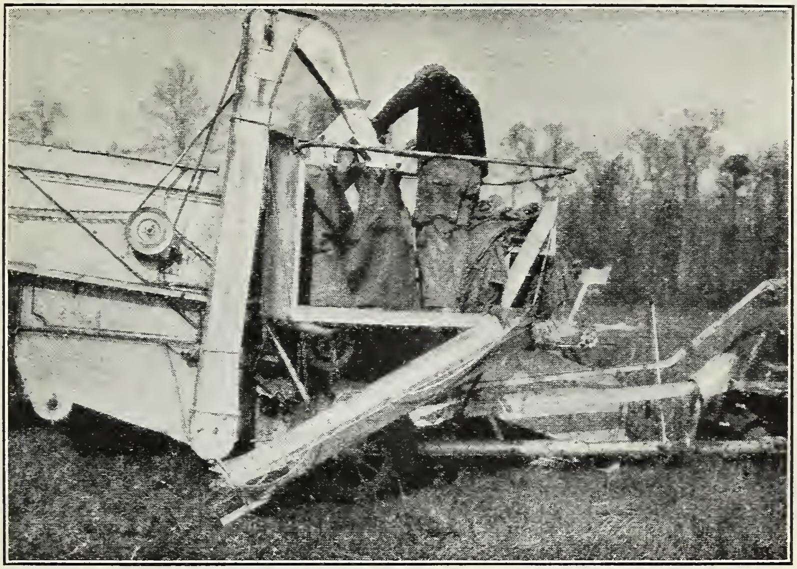

FIGURE 5.—Five-foot combine equipped with sacking attachment.

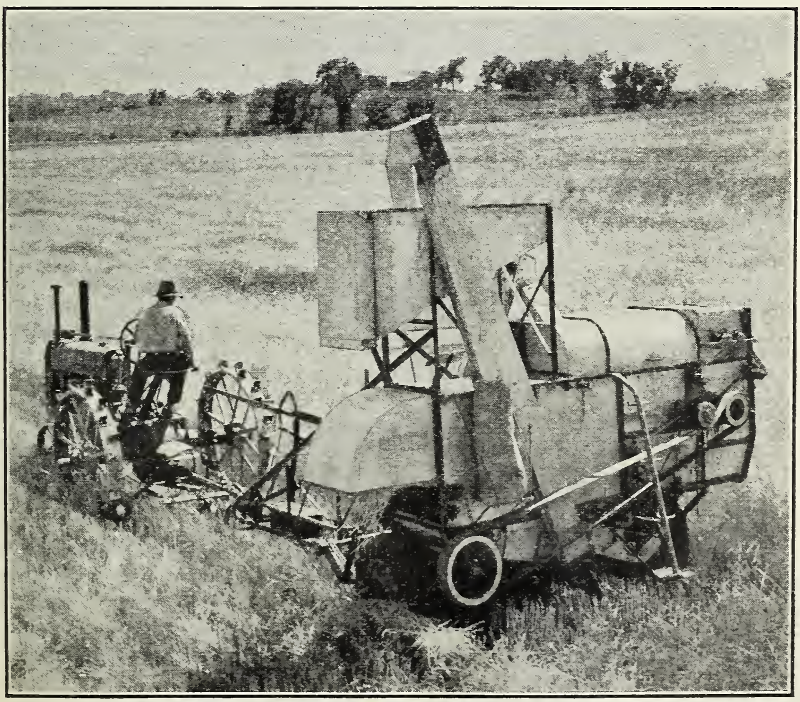

FIGURE 6.—Six-foot power take-off combine equipped with gravity-type grain bin

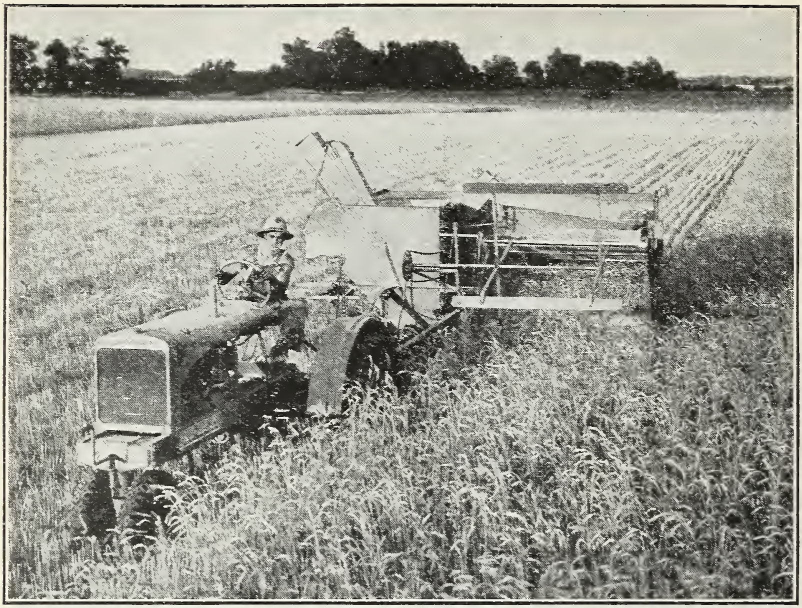

FIGURE 7.—Five-foot power take-off combine with elevator for emptying grain bin.

engine on the machine for operating all moving parts. In areas where soybeans, for example, are grown on ridges and the plant growth is rank, more power may be needed than is available from the power take-off of a two-plow tractor. A 1-foot extension for the cutter bar is also available for one 5-foot machine and a 2-foot extension for some other makes having a 6-foot cut.

HARVESTING WHEAT AND OATS

The 1935 small-grain harvest season in the Corn Belt was abnormal. Plant growth was rank, and grain was light both as to yield and weight per bushel; rains delayed harvest, resulting in lodged crops and abundant weed growth. Harvest was consequently difficult with all types of combines resulting in high cutter bar and threshing losses.

In 1936, crop and weather conditions in the Corn Belt were ideal for combines in harvesting small grain. The season was hot and dry, with practically no lodged grain, very few or no weeds, and the yield was good on many farms. Under such conditions, cutter bar and threshing losses were generally low for all sizes of combines. The extreme of favorable and unfavorable crop and field conditions during the two seasons emphasizes the wide range under which the combine must function. The importance of machine adjustments in obtaining satisfactory performance was also shown.

Results of tests are given in table 1 of combines operating in wheat and oats in 1935 and in 1936. The table shows the size of tractor used, kind of tires, and ground speed when in operation; height of crop harvested and of stubble left, the difference between which indicates the comparative quantities of material going through the combine; class and grade, grade factor, test weight, moisture content, and yield of grain; and the harvesting and threshing losses as determined from the tests.

TABLE 1.—*Losses in harvesting wheat and oats with combines of various sizes tested in 1935 and 1936*

WHEAT, 5- AND 6-FOOT COMBINES, ILLINOIS, 1935

Farm No.	Test No.	Tractor			Crop									Losses										Grain saved
					Height									Harvesting cutter bar		Threshing						Harvesting and threshing		
																Straw		Chaff		Total				
		Plows	Kind of tire [1]	Speed per hour	Crop	Stubble	Yield (field) [2] per acre	Grade and class	Grade factor [3]	Test weight	Moisture	Yield (bin) [4] per acre	Per acre	Percent [5]	Per acre	Percent [6]	Per acre	Percent [6]	Per acre	Percent [6]	Per acre	Percent [7]	
		No.		Miles	In.	In.	Bu.			Pct.	Pct.	Bu.	Bu.		Bu.		Bu.		Bu.		Bu.		Pct.
2	1	3	S	3.9	38	21	46.4					44.8	0.60	1.29	0.65	1.43	0.33	0.71	0.98	2.14	1.58	3.41	96.59
2	2	3	S	3.8	36	21	38.3					36.6	.81	2.11	.35	.93	.50	1.32	.85	2.25	1.66	4.33	95.67
5	1	3	S	3.8	40	22	35.0				12.4	33.6	.61	1.74	.48	1.38	.34	1.00	.82	2.38	1.43	4.08	95.92
5	2	3	S	3.7	39	20	37.1					35.6	.80	2.16	.38	1.05	.37	1.01	.75	2.06	1.55	4.18	95.82
7	1				31	9	20.0					16.0	1.61	8.05	.68	3.41	1.69	8.41	2.37	11.82	3.98	19.90	80.10
8	1	2	R	4.6	29	11	15.1				17.9	12.4	2.52	16.69	.06	.50	.13	1.00	.19	1.50	2.71	17.95	82.05
8	2	2	R	2.8	36	13	38.3					35.5	.81	2.11	.44	1.18	1.54	4.12	1.98	5.30	2.79	7.28	92.72
9	1	2	R	3.8	30	13	24.9				14.7	22.1	1.51	6.06	.15	.63	1.19	5.07	1.34	5.70	2.85	11.45	88.55
9	2	2	R	2.8	33	10	21.0					18.5	1.31	6.24	.06	.31	1.08	5.49	1.14	5.80	2.45	11.67	88.33
10	1	3	R	4.9	28	16	41.9				13.5	39.2	2.32	5.54	.17	.42	.24	.62	.41	1.04	2.73	6.52	93.48
10	2	3	R	4.6	28	15	26.2					23.4	2.32	8.85	.22	.94	.31	1.29	.53	2.23	2.85	10.88	89.12
3	1	3	S		40	20	24.3					22.5	1.31	5.39	.22	.97	.29	1.25	.51	2.22	1.82	7.49	92.51
3	2	3	S	3.1	38	17	18.8					16.2	2.02	10.74	.29	1.73	.26	1.55	.55	3.28	2.57	13.67	86.33
Average				3.8	34	16	29.8				14.6	27.4	1.42	5.92	.32	1.14	.64	2.53	.96	3.67	2.38	9.45	90.55

See footnotes at end of table.

TABLE 1.—*Losses in harvesting wheat and oats with combines of various sizes tested in 1935 and 1936*—Continued

WHEAT, 8-FOOT AND LARGER COMBINES, ILLINOIS, 1935

Farm No.	Test No.	Tractor			Crop								Losses										Grain saved
		Plows	Kind of tire [1]	Speed per hour	Height		Yield (field) [2] per acre	Grade and class	Grade factor [3]	Test weight	Moisture	Yield (bin) [4] per acre	Harvesting cutter bar		Threshing						Harvesting and threshing		
															Straw		Chaff		Total				
					Crop	Stubble							Per acre	Percent [5]	Per acre	Percent [6]	Per acre	Percent [5]	Per acre	Percent [6]	Per acre	Percent [7]	
		No.		*Miles*	*In.*	*In.*	*Bu.*			*Pct.*	*Pct.*	*Bu.*	*Bu.*		*Bu.*		*Bu.*		*Bu.*		*Bu.*		*Pct.*
14	1		S	1.1	30	9	22.3					21.0	0.50	2.24	0.27	1.25	0.55	2.50	0.82	3.75	1.32	5.92	94.08
4	1	3	S	1.5	38	20	34.7				13.5	33.1	1.11	3.20	.23	.68	.22	.65	.45	1.33	1.56	4.50	95.50
4	2	3	S	1.7	38	21	29.1					27.7	1.11	3.81	.11	.39	.14	.48	.25	.87	1.36	4.67	95.33
1	1	3	S		45	22	31.6				11.3	29.7	.30	.95	.48	1.52	1.08	3.45	1.56	4.97	1.86	5.89	94.11
1	2	3	S		46	22	31.7					29.1	.30	.95	.45	1.45	1.80	5.71	2.25	7.16	2.55	8.04	91.96
16	1	3	S	2.5	32	13	28.9					24.0	2.12	7.33	.54	2.03	2.24	8.38	2.78	10.41	4.90	16.96	83.04
17	1	3	S	1.6	30	12	28.7					27.3	.50	1.74	.28	.98	.67	2.37	.95	3.35	1.45	5.05	94.95
18	1	3	S	1.7	33	17	24.3					19.1	3.83	15.76	.60	2.92	.75	3.68	1.35	6.60	5.18	21.32	78.68
Average				1.7	36	17	28.9				12.4	26.4	1.22	4.50	.37	1.40	.93	3.40	1.30	4.80	2.52	9.04	90.96

OATS, 5- AND 6-FOOT COMBINES, ILLINOIS, 1935

Farm No.	Test No.	Plows	Kind of tire [1]	Speed per hour	Height: Crop	Height: Stubble	Yield (field) [2] per acre	Grade and class	Grade factor [3]	Test weight	Moisture	Yield (bin) [4] per acre	Harvesting cutter bar: Per acre	Harvesting cutter bar: Percent [5]	Straw: Per acre	Straw: Percent [6]	Chaff: Per acre	Chaff: Percent [5]	Total: Per acre	Total: Percent [6]	Harvesting and threshing: Per acre	Harvesting and threshing: Percent [7]	Grain saved
6	1	2	S	3.3	27	10	52.5				14.1	51.8	0.19	0.36	0.25	0.48	0.25	0.48	0.50	0.96	0.69	1.31	98.69
6	2	2	S	3.1	28	9	48.2					47.0	.76	1.58	.25	.52	.15	.33	.40	.85	1.16	2.41	97.59
11	1	3	R	3.4	38	16	51.1				13.5	35.4	2.27	4.44	66	1.36	12.80	26.22	13.46	27.58	15.73	30.78	69.22
11	2	3	R	2.7	36	13	34.2					27.7	2.84	8.30	.71	2.26	2.94	9.39	3.65	11.65	6.49	18.98	81.02
12	1	2	R	4.5	28	9	50.2				10.5	32.1	1.32	2.63	.69	1.42	16.11	32.96	16.80	34.38	18.12	36.10	63.90
12	2	2	R	2.4	27	5	53.2					41.7	1.13	2.12	.71	1.37	9.67	18.57	10.38	19.94	11.51	21.64	78.36
Average				3.2	31	10	48.2				12.7	39.3	1.42	3.24	.54	1.23	6.99	14.66	7.53	15.89	8.95	18.54	81.46

WHEAT, 5- AND 6-FOOT COMBINES, OHIO, 1936

1	1	2	R	3.6	36	17	31.4	3, red winter tuf	M. e. o. g.	58.5	14.2	31.0	0.33	1.05	0.04	0.12	0.07	0.22	0.11	0.34	0.44	1.40	98.60
1	2	2	R	3.7	36	13	16.8	2, red winter	T. w.														
									M. e. o. g.	59.1	13.3	16.4	.33	1.96	.01	.06	.04	.23	.05	.29	.38	2.26	97.74
1	3	2	R	3.5	36	13	30.7					30.3	.33	1.07	.01	.03	.09	.28	.10	.31	.43	1.40	98.60
2	1	2	R	4.0	33	11	22.0	2, red winter	M. e. o. g.	60.4	10.6	21.7	.20	.91	.01	.07	.05	.21	.06	.28	.26	1.18	98.82
2	2	2	R	4.0	34	6	20.5					20.1	.22	1.07	.01	.05	.16	.78	.17	.83	.39	1.90	98.10
3	1	2	S	3.9	42	12	33.5	2, red winter	M. e. o. g.	61.0	10.2	32.0	1.33	3.97	.02	.05	.14	.45	.16	.50	1.49	4.45	95.55
3	2	2	S	3.8	40	10	28.4			59.0		27.0	1.25	4.40	.02	.06	.08	.31	.10	.37	1.35	4.75	95.25
4	1	2	S	3.6	32	9	25.1	1, red winter		60.5	10.9	24.7	.17	.68	.02	.07	.17	.69	.19	.76	.36	1.43	98.57
4	2	2	S	3.8	31	9	20.7			61.4	10.9	20.3	.33	1.59	.05	.23	.03	.16	.08	.39	.41	1.98	98.02
6	1	2	R	3.0	29	8	14.6	2, red winter	T. w.	58.8	10.8	13.8	.58	3.97	.02	.18	.22	1.55	.24	1.73	.82	5.62	94.38
6	2	2	R	3.0	38	14	19.6	do	T. w.	59.5	10.8	17.8	1.50	7.65	.05	.28	.24	1.33	.29	1.61	1.79	9.13	90.87
7	1	2	S	3.7	32	16	26.4	1, red winter		61.0	10.8	25.7	.50	1.89	.10	.39	.13	.51	.23	.90	.73	2.77	97.23
7	2	2	S	4.8	32	12	23.0					22.5	.33	1.43	.03	.15	.12	.52	.15	.67	.48	2.09	97.91
9	1	2	R	4.5	30	8	16.2					15.6	.50	3.09	.01	.05	.07	.48	.08	.53	.58	3.58	96.42
9	2	2	R	4.2	34	12	26.7					26.2	.28	1.05	.03	.13	.17	.63	.20	.76	.48	1.80	98.20
9	3	2	R	3.5	36	11	23.9					23.6	.17	.71	.03	.11	.08	.35	.11	.46	.28	1.17	98.83
10	1	2	S	3.3	34	11	18.4					18.1	.17	.92	.03	.18	.08	.46	.11	.64	.28	1.52	98.48
12	1		R	3.3	36	12	26.9	2, red winter	T. w.	58.0	9.6	26.3	.50	1.86	.03	.13	.05	.17	.08	.30	.58	2.16	97.84
14	1	2	R	3.8	32	6	23.0	do	T. w.	59.0	12.9	22.8	.13	.57	.03	.12	.04	.18	.07	.30	.20	.87	99.13
16	1	2	R	4.6	37	7	24.1	do	T. w.	59.0	13.5	22.9	1.08	4.48	.02	.07	.05	.22	.07	.29	1.15	4.77	95.23
16	2	2	R	3.7	31	8	24.0					23.0	.92	3.83	.01	.04	.02	.08	.03	.12	.95	3.96	96.04
16	3	2	R	3.5	34	7	28.5		T. w.	59.0	13.3	27.1	1.17	4.10	.01	.03	.22	.79	.23	.82	1.40	4.91	95.09
20	1		R	4.1	41	13	14.8	Mixed grain		56.7	8.9	14.3	.42	2.84	.02	.12	.03	.23	.05	.35	.47	3.18	96.82
22	1	2	S	4.1	42	19	26.7					26.3	.17	.64	.07	.25	.18	.69	.25	.94	.42	1.57	98.43
23	1		R	3.3	36	14	15.9			58.5		15.8	.13	.82	.00	.01	.01	.04	.01	.05	.14	.88	99.12
25	1	2	R	4.2	35	9	32.8			59.5	13.5	31.5	1.00	3.05	.01	.04	.24	.76	.25	.80	1.25	3.81	96.19
25	2	2	R	3.5	35	9	29.5					28.3	1.00	3.39	.01	.03	.15	.54	.16	.57	1.16	3.93	96.07
25	3	2	R	3.1	35	10	30.6					29.4	1.00	3.27	.01	.03	.15	.51	.16	.54	1.16	3.79	96.21

WHEAT, 5- AND 6-FOOT COMBINES, INDIANA, 1936

1	2	2	R	3.9	27	9	12.2	4, hard winter	Dam.	58.5	9.1	11.7	0.43	3.52	0.01	0.08	0.05	0.42	0.06	0.50	0.49	4.02	95.98
4	1	2	S	4.2	28	8	13.2	3, red winter	T. w.	56.7	9.1	12.3	.57	4.32	.00	.03	.32	2.53	.32	2.56	.89	6.74	93.26
5	1	2	R	4.7	27	6	12.7	2, hard winter	T. w.	59.3	9.1	12.4	.18	1.42	.10	.80	.01	.11	.11	.91	.29	2.28	97.72
6	1	2	R	3.1	33	10	12.7	3, hard winter	T. w.	57.4	11.3	11.7	.82	6.46	.10	.85	.05	.45	.15	1.30	.97	7.64	92.36

See footnotes at end of table.

TABLE 1.—*Losses in harvesting wheat and oats with combines of various sizes tested in 1935 and 1936*—Continued

WHEAT, 5- AND 6-FOOT COMBINES, ILLINOIS, 1936

Farm No.	Test No.	Tractor			Crop								Losses										Grain saved
					Height								Harvesting cutter bar		Threshing						Harvesting and threshing		
															Straw		Chaff		Total				
		Plows	Kind of tire [1]	Speed per hour	Crop	Stubble	Yield (field)[2] per acre	Grade and class	Grade factor [3]	Test weight	Moisture	Yield (bin)[4] per acre	Per acre	Percent [5]	Per acre	Percent [6]	Per acre	Percent [6]	Per acre	Percent [6]	Per acre	Percent [7]	
		No.		Miles	In.	In.	Bu.			Pct.	Pct.	Bu.	Bu.		Bu.		Bu.		Bu.		Bu.		Pct.
2	1	3	S	2.9	38	15	37.7	1, mixed grain		60.1	13.7	37.3	0.20	0.53	0.06	0.16	0.15	0.40	0.21	0.56	0.41	1.09	98.91
3	1	3	R	5.0	33	14	34.5	1, yellow hard winter		60.4	10.2	33.8	.40	1.16	.14	.40	.20	.60	.34	1.00	.74	2.14	97.86
3	2	3	R	5.2	32	13	30.4					29.6	.50	1.64	.04	.15	.27	.90	.31	1.05	.81	2.66	97.34
4	1	3	T	3.5	31	15	36.8	1, yellow hard winter		60.0	10.0	36.3	.30	.82	.07	.20	.09	.25	.16	.45	.46	1.25	98.75
4	2	3	T	3.5	31	16	32.9					32.2	.50	1.52	10	.31	.10	.31	.20	.62	.70	2.13	97.87
5	1	3	S	3.8	34	17	33.7	2, red winter	T. w	58.7	10.9	33.0	.40	1.19	.14	.41	.21	.62	.35	1.03	.75	2.22	97.78
5	2	3	S	4.0	39	16	34.8					34.2	.40	1.15	.01	.02	.16	.46	.17	.48	.57	1.64	98.36
6	1	2	S	2.7	34	17	41.8	2, dark hard winter	T. w	58.7	11.3	40.7	.50	1.20	.22	.52	.34	.84	.56	1.36	1.06	2.54	97.46
6	2	2	S	2.5	37	17	43.1					42.0	.50	1.16	.21	.48	.41	.96	.62	1.44	1.12	2.60	97.40
9	1	2	R	5.3	35	19	46.4	1, red winter		60.6	11.1	46.5	.40	.86	.16	.35	.27	.58	.43	.93	.83	1.79	98.21
9	2	2	R	3.6	35	21	39.6					39.1	.25	.63	.08	.19	.13	.32	.21	.51	.46	1.16	98.84
10	1	2	R	3.4	37	17	40.9	1, red winter		60.3	10.0	40.5	.20	.49	.08	.19	.09	.21	.17	.40	.37	.90	99.10
10	2	2	R	3.6	38	16	38.4					38.2	.10	.26	.01	.02	.09	.23	.10	.25	.20	.52	99.48
13	1	2	R	3.9	37	16	36.9					36.4	.50	1.36	.01	.02	.03	.08	.04	.10	.54	1.46	98.54
13	2	2	R	3.7	37	16	35.8	2, dark hard winter	T. w	59.3	9.6	35.1	.61	1.70	.01	.02	.04	.13	.05	.15	.66	1.84	98.16
28	1	2	R	3.4	33	12	49.3	2, mixed grain	T. w	59.5	11.7	48.5	.40	.81	.10	.20	.27	.56	.37	.76	.77	1.56	98.44
28	2	2	R	3.5	33	11	44.0					43.4	.30	.68	.09	.20	.26	.59	.35	.79	.65	1.48	98.52
33	1	2–3	S	2.7	37	17	27.8	1, red winter		60.0	10.2	27.4	.10	.36	.13	.46	.18	.67	.31	1.13	.41	1.47	98.53
33	2	2–3	S	2.7			42.4					41.8	.10	.24	.10	.24	.35	.83	.45	1.07	.55	1.30	98.70
Average				3.7	34	12	28.5			59.3	11.2	27.8	.48	1.95	.05	.18	.14	.52	.19	.70	.67	2.63	97.37

WHEAT, 8-FOOT AND LARGER COMBINES, OHIO, 1936

11	1	2	S	3.7	33	13	24.4	1, red winter		60.6	10.3	23.9	0.42	1.72	0.01	0.03	0.08	0.33	0.09	0.36	0.51	2.09	97.91
17	1	2	S	2.4	38	14	19.1	do		60.7	11.6	18.2	.17	.87	.02	.13	.74	3.92	.76	4.05	.93	4.84	95.16
18	1	2	S	3.1	42	17	35.2	do		62.2	10.1	34.6	.25	.71	.02	.05	.33	.94	.35	.99	.60	1.70	98.30
18	2	2	S	3.1	42	17	38.3					37.6	.33	.86	.02	.04	.32	.83	.34	.87	.67	1.75	98.25
21	1	2	S	3.4	28	7	12.3					11.8	.50	4.07	.00	.01	.01	.07	.01	.08	.51	4.15	95.85
15	1	3	S	2.6	32	6	23.9	3, red winter	T. w	57.0	11.1	23.4	.17	.71	.10	.43	.25	1.05	.35	1.48	.52	2.17	97.83
24	1	2	R	3.5	33	15	19.7					19.2	.42	2.13	.01	.03	.11	.58	.12	.61	.54	2.74	97.26
24	2	2	R	3.5	33	15	14.7					14.2	.42	2.86	.01	.06	.07	.52	.08	.58	.50	3.40	96.60
5	1	3	R	3.1	28	8	15.4	1, red winter		60.0	9.8	14.9	.45	2.92	.02	.11	.03	.21	.05	.32	.50	3.25	96.75
8	1	2	R	3.0	30	11	17.5	2, red winter	T. w	58.3	9.8	17.1	.33	1.89	.03	.15	.06	.34	.09	.49	.42	2.40	97.60
13	1	2	R	2.6	30	12	23.6	do	T. w	59.2	12.7	23.4	.21	.89	.01	.04	.02	.10	.03	.14	.24	1.02	98.98
19	1	3	R	3.3	34	14	20.5	1, red winter		60.5	11.8	19.8	.33	1.61	.07	.33	.25	1.24	.32	1.57	.65	3.17	96.83
19	2	3	R	3.5	34	12	22.3					21.7	.33	1.48	.02	.08	.25	1.14	.27	1.22	.60	2.69	97.31

WHEAT, 8-FOOT AND LARGER COMBINES, INDIANA, 1936

1	1	2	R	2.5	30	13	10.8	2, hard winter	T. w	59.2	8.8	10.4	0.36	3.33	0.01	0.07	0.05	0.53	0.06	0.60	0.42	3.89	96.11

WHEAT, 8-FOOT AND LARGER COMBINES, ILLINOIS, 1936

1	2	3	S	2.6	39	21	47.3	1, dark hard winter		62.2	8.8	46.5	0.60	1.27	0.02	0.05	0.20	0.42	0.22	0.47	0.82	1.73	98.27
7	1			2.2	36	11	31.1	1, red winter		60.0	10.8	30.3	.50	1.61	.09	.29	.23	.76	.32	1.05	.82	2.64	97.36
7	2		T	1.9	36	17	39.4					38.4	.61	1.55	.13	.34	.28	.71	.41	1.05	1.02	2.59	97.41
8	1	2	T	3.5	35	22	39.9	1 red winter		61.0	12.1	38.7	.40	1.00	.04	.12	.76	1.91	.80	2.03	1.20	3.01	96.99
8	2	2	S	3.1	33	22	39.5					38.8	.30	.76	.04	.11	.34	.88	.38	.99	.68	1.72	98.28
11	1	2–3	S	3.1	39	21	38.3	2 dark hard winter	T. w	59.7	9.4	35.6	.50	1.31	.04	.11	2.20	5.82	2.24	5.93	2.74	7.15	92.85
11	2	2–3	S	3.0	37	18	37.7					36.9	.50	1.33	.04	.11	.29	.77	.33	.88	.83	2.20	97.80
12	1	3	S	2.7	35	20	38.8	1, dark hard winter		61.5	9.0	38.0	.61	1.57	.11	.30	.12	.32	.23	.62	.84	2.16	97.84
17	1	2–3	S	2.6	27	12	23.6	2, dark hard winter	T. w	59.4	8.8	22.7	.10	.42	.23	.97	.60	2.53	.83	3.50	.93	3.94	96.06
17	2	2–3	S	2.9	23	12	21.2					19.5	.71	3.35	.09	.42	.93	4.54	1.02	4.96	1.73	8.16	91.84
23	1	3–5	S	2.0	25	11	28.4	1, hard winter		60.3	10.1	27.8	.50	1.76	.01	.03	.04	.16	.05	.19	.55	1.94	98.06
23	2	3–5	S	3.4	24	12	23.9					23.5	.40	1.67	.00	.01	.03	.13	.03	.14	.43	1.80	98.20
25	1	3	S	1.9	32	7	30.6	2, dark winter	T. w	59.5	11.5	28.7	1.71	5.59	.02	.06	.19	.65	.21	.71	1.92	6.27	93.73
25	2	3	S	2.0	27	6	24.2					23.6	.10	.41	.08	.34	.42	1.75	.50	2.09	.60	2.48	97.52
Average				2.9	33	14	27.2			60.1	10.4	26.4	.43	1.61	.05	.17	.33	1.23	.38	1.40	.81	2.98	97.02

See footnotes at end of table.

TABLE 1.—*Losses in harvesting wheat and oats with combines of various sizes tested in 1935 and 1936*—Continued

Farm No.	Test No.	Tractor: Plows	Tractor: Kind of tire [1]	Tractor: Speed per hour	Crop: Height: Crop	Crop: Height: Stubble	Crop: Yield (field)[2] per acre	Crop: Grade and class	Crop: Grade factor [3]	Crop: Test weight	Crop: Moisture	Crop: Yield (bin)[4] per acre	Losses: Harvesting cutter bar: Per acre	Losses: Harvesting cutter bar: Percent [5]	Losses: Threshing: Straw: Per acre	Losses: Threshing: Straw: Percent [6]	Losses: Threshing: Chaff: Per acre	Losses: Threshing: Chaff: Percent [6]	Losses: Threshing: Total: Per acre	Losses: Threshing: Total: Percent [6]	Losses: Harvesting and threshing: Per acre	Losses: Harvesting and threshing: Percent [7]	Grain saved
		No.		*Miles*	*In.*	*In.*	*Bu.*			*Pct.*	*Pct.*	*Bu.*	*Bu.*		*Bu.*		*Bu.*		*Bu.*		*Bu.*		*Pct.*
OATS, 5- AND 6-FOOT COMBINES, INDIANA, 1936																							
2	1	2	R	3.8	27	9	47.9	1, heavy bright white		35.0	8.5	47.1	0.07	0.15	0.08	0.18	0.61	1.27	0.69	1.45	0.76	1.59	98.41
3	1	2	S	4.3	27	11	37.7	1, bright white		32.0	9.0	35.8	1.33	3.53	.08	.21	.52	1.43	.60	1.64	1.93	5.12	94.88
10	1	2	R	3.3	32	12	33.2	2, bright white	T. w	31.0	9.5	32.1	.27	.81	.19	.57	.68	2.07	.87	2.64	1.14	3.43	96.57
11	1	2	S	3.1	28	9	34.3	2, bright white cereal	T. w	31.0	8.8	32.8	.20	.58	.09	.26	1.21	3.56	1.30	3.82	1.50	4.37	95.63
12	1	2	S	4.1	31	9	33.6	1, bright white cereal		32.5	8.0	32.8	.27	.80	.06	.19	.43	1.30	.49	1.49	.76	2.26	97.74
15	1	2	R	4.0	35	9	50.5	1, bright white heavy		36.0	12.8	45.6	.34	.67	.08	.16	4.43	8.84	4.51	9.00	4.85	9.60	90.40
17	1	2	R	2.0	30	8	48.3	3, bright white	T. w	29.0	12.1	47.4	.53	1.10	.20	.42	.14	.28	.34	.70	.87	1.80	98.20
OATS, 5- AND 6-FOOT COMBINES, ILLINOIS, 1936																							
14	1	3	S	4.3	22	9	38.6	3, bright white	T. w	28.0	9.2	38.1	0.19	0.49	0.01	0.02	0.34	0.89	0.35	0.91	0.54	1.40	98.60
14	2	3	S	4.6	23	7	40.0					39.3	.19	.47	.02	.05	.53	1.34	.55	1.39	.74	1.85	98.15
19	1	2	S	2.9	23	8	32.3	1, bright white cereal		32.0	8.2	31.3	.19	.59	.02	.07	.82	2.55	.84	2.62	1.03	3.19	96.81
19	2	2	S	3.4	24	7	26.8					25.9	.38	1.42	.05	.20	.49	1.84	.54	2.04	.92	3.43	96.57
30	1	2	R	4.2	27	9	31.1	2, bright white	T. w	31.0	11.4	29.3	1.51	4.86	.09	.29	.21	.73	.30	1.02	1.81	5.82	94.18
30	2	2	R	4.1	27	9	36.3					35.1	.94	2.59	.06	.16	.17	.48	.23	.64	1.17	3.22	96.78
32	1	2–3	S	4.4	21	6	25.9	3, bright white	T. w	28.0	12.8	22.7	.95	3.67	1.65	6.59	.61	2.46	2.26	9.05	3.21	12.39	87.61
32	2	2–3	S	4.1			19.0					18.1	.19	1.00	.54	2.84	.23	1.25	.77	4.09	.96	5.05	94.95
Average				3.8	27	9	35.7			31.4	10.0	34.2	.50	1.52	.22	.81	.76	2.02	.98	2.83	1.48	4.30	95.70

OATS, 8-FOOT AND LARGER COMBINES, INDIANA, 1936

1	3	2	R	2. 5	30	10	26. 8	4, bright white	T. w	26. 5	8. 3	26. 4	0. 20	0. 75	0. 17	0. 62	0. 06	0. 23	0. 23	0. 85	0. 43	1. 60	98. 40
8	1	2	S	2. 7	21	8	33. 2	3, bright white	T. w	29. 5	8. 6	32. 6	. 20	. 60	. 06	. 18	. 30	. 92	. 36	1. 10	. 56	1. 69	98. 31
9	1	2	R	2. 8	26	11	38. 0	4, white	T. w	25. 0	11. 6	37. 6	. 20	. 53	. 17	. 44	. 07	. 19	. 24	. 63	. 44	1. 16	98. 84
13	1	2	R	3. 4	28	10	55. 2	2, bright white	T. w	30. 0	9. 5	53. 9	. 13	. 24	. 17	. 30	1. 01	1. 83	1. 18	2. 13	1. 31	2. 37	97. 63
14	1	2	S	3. 1	32	13	62. 8	3, bright white	T. w	29. 0	10. 6	61. 6	. 33	. 53	. 05	. 08	. 84	1. 34	. 89	1. 42	1. 22	1. 94	98. 06
16	1	2	S	2. 3	27	10	39. 6	4, bright white	T. w	25. 5	10. 9	36. 6	. 33	. 83	. 11	. 27	2. 59	6. 57	2. 70	6. 84	3. 03	7. 65	92. 35
16	2	2	S	2. 3	27	10	42. 9	do	T. w	26. 0	10. 7	41. 9	. 40	. 93	. 11	. 27	. 50	1. 18	. 61	1. 45	1. 01	2. 35	97. 65

OATS, 8-FOOT AND LARGER COMBINES, ILLINOIS, 1936

15	1	2	S	3. 8	20	8	27. 6	3, bright white	T. w	28. 5	9. 1	26. 8	0. 19	0. 69	0. 14	0. 53	0. 51	1. 84	0. 65	2. 37	0. 84	3. 04	96. 96
15	2	2	S	3. 6	23	6	29. 3					27. 6	. 19	. 65	. 10	. 33	1. 40	4. 83	1. 50	5. 16	1. 69	5. 77	94. 23
16	1	3	(8)	2. 6	21	7	39. 9	2, bright white cereal	T. w	30. 5	9. 3	39. 3	. 19	. 48	. 01	. 02	. 43	1. 08	. 44	1. 10	. 63	1. 58	98. 42
16	2	3	(8)	2. 5	21	6	38. 6					37. 8	. 19	. 49	. 01	. 01	. 60	1. 56	. 61	1. 57	. 80	2. 07	97. 93
18	1	3	S	4. 1	24	8	22. 0	3, bright white	T. w	27. 0	7. 8	21. 4	. 19	. 86	. 14	. 66	. 27	1. 25	. 41	1. 91	. 60	2. 73	97. 27
18	2	3	S	3. 9	21	7	19. 4					18. 5	. 19	. 98	. 20	1. 06	. 48	2. 48	. 68	3. 54	. 87	4. 48	95. 52
20	1	2	S	3. 6	18	6	25. 6	3, bright white	T. w	29. 5	8. 2	24. 2	. 57	2. 23	. 11	. 46	. 71	2. 81	. 82	3. 27	1. 39	5. 43	94. 57
21	1	3	S	2. 9	26	8	42. 1	4, bright white	T. w	25. 5	8. 9	41. 3	. 19	. 45	. 18	. 42	. 48	1. 15	. 66	1. 57	. 85	2. 02	97. 98
22	1	3	S	3. 1	26	9	37. 4	3, bright white	T. w	29. 0	8. 6	35. 4	1. 32	3. 53	. 14	. 40	. 53	1. 47	. 67	1. 87	1. 99	5. 32	94. 68
22	2	3	S	3. 3	27	10	29. 3					28. 2	. 57	1. 94	. 16	. 54	. 36	1. 26	. 52	1. 80	1. 09	3. 72	96. 28
24	1	3–4	S	2. 3	20	8	42. 0	3, bright white	T. w	28. 0	11. 6	40. 2	. 94	2. 24	. 27	. 65	. 59	1. 43	. 86	2. 08	1. 80	4. 29	95. 71
26	1	3–4	S	2. 8	23	6	56. 1	1, bright white		34. 0	8. 2	53. 4	. 94	1. 68	. 04	. 07	1. 72	3. 11	1. 76	3. 18	2. 70	4. 81	95. 19
26	2	3–4	S	3. 9	23	6	45. 5					42. 7	. 95	2. 09	. 13	. 30	1. 70	3. 81	1. 83	4. 11	2. 78	6. 11	93. 89
26	3	3–4	S		23	5	43. 2					42. 1	. 57	1. 32	. 03	. 06	. 53	1. 33	. 56	1. 39	1. 13	2. 61	97. 39
27	1	3–4	S	2. 7	27	7	31. 3	4, bright white	T. w	26. 0	8. 1	23. 7	. 57	1. 82	. 15	. 49	6. 84	22. 29	6. 99	22. 78	7. 56	24. 15	75. 85
27	2	3–4	S	2. 8	30	9	36. 2					33. 9	. 57	1. 57	. 11	. 31	1. 64	4. 61	1. 75	4. 92	2. 32	6. 41	93. 59
29	1	2–3	S	4. 5	27	10	33. 6	3, bright white	T. w	28. 5	13. 3	30. 9	. 95	2. 83	. 14	. 44	1. 63	4. 99	1. 77	5. 43	2. 72	8. 09	91. 91
29	2	2–3	S	3. 1	26	12	34. 7					32. 5	. 76	2. 19	. 10	. 29	1. 33	3. 93	1. 43	4. 22	2. 19	6. 31	93. 69
31	1	3	S	3. 2	31	5	42. 3	2, bright white	T. w	30. 0	10. 3	34. 7	. 75	1. 77	. 19	. 45	6. 68	16. 08	6. 87	16. 53	7. 62	18. 01	81. 99
31	2	3	S	3. 2	29	10	44. 2					36. 7	1. 70	3. 85	. 12	. 27	5. 66	13. 35	5. 78	13. 62	7. 48	16. 92	83. 08
31	3	3	S	2. 2	31	12	36. 9					36. 2	. 19	. 51	. 05	. 13	. 48	1. 30	. 53	1. 43	. 72	1. 95	98. 05
Average				3. 1	25	8	37. 7			28. 2	9. 6	35. 6	. 51	1. 38	. 12	. 36	1. 43	3. 86	1. 55	4. 22	2. 06	5. 52	94. 48

1 R=rubber, S=steel, T=track.
2 Bin yield plus all losses.
3 T. w.=test weight; M. e. o. g.=matter except other grain; dam=damaged.
4 Net grain saved.
5 Based on field yield.
6 Based on bin yield plus threshing losses.
7 Based on field yield and all losses per acre.
8 Front, rubber; rear, steel.

For convenience, harvesting loss is referred to as cutter-bar loss, threshing loss as straw loss indicating grain left in unthreshed heads, and chaff loss indicating threshed grain thrown out of the machine with the chaff or straw. Bin yield refers to the net amount of threshed grain saved or caught under test and converted to an acre basis. This amount caught under test plus that recovered from the unthreshed heads and from the chaff constitutes a base with which the respective straw and chaff percentage losses are determined. The field yield shown in table 1 is the sum of the bin yield and all losses, including cutter-bar loss, on a basis of bushels per acre. The field yield is the basis upon which the cutter-bar percentage loss is determined, as is also the case in determining total harvesting and threshing percentage loss. Cutter-bar and threshing losses are shown both in percent and in bushels per acre for the convenience of the reader who may think in terms of one or the other units of measure. In the last column, table 1, grain saved is intended to convey in positive terms just what percentage of the crop is saved by this method of harvest. The data shown in the table will be discussed in detail in the following pages.

In fields where the combined straw and chaff loss was not more than 2 or 3 percent, recommendations for machine adjustments or method of operation for reducing these losses generally were not made. Where higher losses occurred or adjustments were made for other reasons and followed by additional tests, results are given in table 4 together with information as to machine adjustments and crop conditions.

HARVESTING SOYBEANS

Crop and weather conditions in Illinois during the 1935 soybean harvest season were normal except for excessive rain and snow during the latter part. For this reason many fields were not harvested until after January 1, 1936. All tests in connection with the study herein reported for 1935 were made during October and November.

In the Mississippi Delta crop and field conditions were generally favorable especially during the early part of the 1935 season. Rains interfered with harvest to a considerable extent during November although a large part of the crop was harvested before November 1.

The 1936 soybean growing season in Illinois was dry followed by late summer rains and comparatively late frost. For these reasons second growth occurred, resulting in irregular maturity and low-quality soybeans. Immature beans and succulent plants interfered with threshing operations. There was also a tendency on the part of many farmers, remembering adverse conditions encountered during the latter part of the 1935 season, to start their combines before the crop was ready to harvest.

The 1936 soybean crop in the Mississippi Delta was poor due to dry weather. Difficulty was experienced in locating fields where the yield was sufficient to justify harvesting operations.

In soybeans, as with small grain, an attempt was made to determine the performance characteristics of combines as operated by farmers. Results of all tests made in 1935 and 1936 are given in table 2, which is similar to table 1 for small grain.

In table 4 more detailed information is given for fields where adjustments were made in an effort to improve the performance of a machine.

TABLE 2.—*Losses in harvesting soybeans with combines of various sizes tested in 1935 and 1936*

5- AND 6-FOOT COMBINES, ILLINOIS, 1935

Farm No.	Test No.	Tractor			Height		Yield (field) per acre [2]	U. S. grade and class [3]	Grade factor [4]	Test weight per bushel	Moisture	Splits	Damage	Foreign material	Yield (bin)[5] per acre	Losses										Grain saved
																Harvesting, cutter-bar		Threshing						Harvesting and threshing		
																		Straw		Chaff		Total				
		Plows	Speed per hour	Tire [1]	Crop	Stubble										Per acre	Percent [6]	Per acre	Percent [7]	Per acre	Percent [7]	Per acre	Percent [7]	Per acre	Percent [8]	
		No.	Miles		In.	In.	Bu.			Lbs.	Pct.	Pct.	Pct.	Pct.	Bu.	Bu.		Bu.		Bu.		Bu.		Bu.		Pct.
1	1	3	3.8	S	35	5	28.8	2 y	Spl., F. m.		10.5	8.2	Tr.	1.1	27.4	1.01	3.50	0.19	0.68	0.22	0.80	0.41	1.48	1.42	4.93	95.07
1	2	3	3.6	S	34.6	6.7	31.4								29.8	1.26	4.01	.15	.49	.22	.74	.37	1.23	1.63	5.19	94.81
2	1	2		S	42	5.5	26.6	2 y	Spl., F. m.		12.0	8.8	0.2	0.7	24.3	2.02	7.59	.06	.24	.17	.67	.23	.91	2.25	8.46	91.54
2	2	2	4.1	S	36.6	5.6	25.2								23.1	1.89	7.50	.05	.23	.16	.69	.21	.92	2.10	8.33	91.67
4	1	2	2.7	S	15	3	39.8	2 y	Spl., F. m.		10.7	8.6	.4	.9	37.2	2.02	5.08	.31	.82	.27	.72	.58	1.54	2.60	6.53	93.47
4	2	2	2.7	S	15	3	34.3								32.8	1.01	2.94	.31	.92	.21	.64	.52	1.56	1.53	4.46	95.56
6	1	2	3.3	S	25	5.5	31.9	3 y	Spl		12.5	14.0	.5	.7	29.1	2.52	7.90	.10	.33	.16	.55	.26	.88	2.78	8.71	91.29
6	2	2	3.3	S	25	5.5	34.6								31.7	2.77	8.01	.07	.21	.10	.32	.17	.53	2.94	8.50	91.50
7	1	2	2.1	S	33	4	28.4	2 y	Spl		13.0	2.0	.2	.1	26.5	1.76	6.20	.08	.30	.09	.35	.17	.65	1.93	6.80	93.20
7	2	2	3.1	S	33	4	27.6								26.2	1.26	4.57	.07	.26	.08	.31	.15	.57	1.41	5.11	94.89
8	1	2	3.2	S	30	5	33.5	3 y	Spl		12.0	18.0	.5	.2	30.9	2.52	7.52	.04	.12	.08	.25	.12	.37	2.64	7.88	92.12
8	2	2	3.2	S	30	5	33.7								31.5	2.02	5.99	.07	.21	.08	.27	.15	.48	2.17	6.44	93.56
9	1	2	3.4	S	25	5	12.1	Sample	Spurge nettle.		13.2	1.5	.3	1.2	11.5	.50	4.13	.09	.77	.05	.39	.14	1.16	.64	5.29	94.71
9	2	2	3.7	S	25	5	10.6								10.0	.50	4.72	.09	.84	.03	.28	.12	1.12	.62	5.85	94.15
11	1	2	4.6	R	29	5.5	41.0	3 y	Dam		11.8	3.4	3.2	.5	37.3	2.52	6.15	.23	.60	.96	2.50	1.19	3.10	3.71	9.05	90.95
11	2	2	4.9	R	29	5.5	40.2								35.3	4.03	10.02	.06	.16	.84	2.31	.90	2.47	4.93	12.26	87.74
12	1	2	4.2	R	34	5.5	37.0	3 y	Spl		12.8	10.4	.4	.4	33.3	3.53	9.54	.02	.05	.13	.40	.15	.45	3.68	9.95	90.05
12	2	2	4.2	R	34	5.5	42.3								37.5	4.54	10.73	.01	.03	.27	.72	.28	.75	4.82	11.39	88.61
14	1	2	3.9	S	28	6	19.6	2 y	Spl		14.4	1.8	.5	.1	17.6	1.61	8.21	.16	.87	.24	1.31	.40	2.18	2.01	10.25	89.75
14	2	2	3.9	S	28	6	15.6								14.4	1.01	6.47	.07	.45	.16	1.09	.23	1.54	1.24	7.95	92.05
15	1	2	5.2	R	26	5	28.0	2 y	Spl		13.2	8.3	.1	.5	24.2	3.53	12.61	.03	.11	.22	.88	.25	.99	3.78	13.50	86.50
15	2	2	5.4	R	26	5	21.5								19.3	2.02	9.40	.03	.13	.18	.94	.21	1.07	2.23	10.37	89.63
16	1	2	2.5	R	36	5.5	23.2	2 y	Spl., F. m.		13.0	2.0	.2	1.2	21.4	1.51	6.51	.16	.75	.14	.66	.30	1.41	1.81	7.80	92.20
16	2	2	4.1	R	36	5.5	27.8								25.1	2.22	7.98	.12	.47	.36	1.42	.48	1.89	2.70	9.71	90.29
21	1	3	4.3	S	18	6	29.5	3 y	Moist		16.4	3.8	.6	.2	25.9	2.27	7.69	.94	3.45	.39	1.45	1.33	4.90	3.60	12.20	87.80

See footnotes at end of table.

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TABLE 2.—*Losses in harvesting soybeans with combines of various sizes tested in 1935 and 1936*—Continued

5- AND 6-FOOT COMBINES, ILLINOIS, 1935—Continued

Farm No.	Test No.	Tractor: Plows	Tractor: Speed per hour	Tractor: Tire [1]	Height: Crop	Height: Stubble	Yield (field) per acre [2]	U. S. grade and class [3]	Grade factor [4]	Test weight per bushel	Moisture	Splits	Damage	Foreign material	Yield (bin (per acre [5]	Losses: Harvesting, cutter-bar: Per acre	Losses: Harvesting, cutter-bar: Percent [6]	Losses: Threshing: Straw: Per acre	Losses: Threshing: Straw: Percent [7]	Losses: Threshing: Chaff: Per acre	Losses: Threshing: Chaff: Percent [7]	Losses: Threshing: Total: Per acre	Losses: Threshing: Total: Percent [7]	Losses: Harvesting and threshing: Per acre	Losses: Harvesting and threshing: Percent [8]	Grain saved
		No.	Miles		In.	In.	Bu.			Lbs.	Pct.	Pct.	Pct.	Pct.	Bu.	Bu.		Bu.		Bu.		Bu.		Bu.		Pct.
21	2	3	4.1	S	18	6	22.0								19.3	1.51	6.88	.66	3.20	.52	2.56	1.18	5.76	2.69	12.23	87.77
20	1	2	3.0	S	15	4	33.4	2 y	Spl., F. m.		14.9	4.7	1.0	2.0	27.6	2.77	8.29	2.07	6.75	.98	3.19	3.05	9.94	5.82	17.42	82.58
20	2	2	2.9	S	15	4	32.3								26.1	3.53	10.93	1.66	5.77	1.01	3.52	2.67	9.29	6.20	19.20	80.80
Average			3.7		28	5	29.0				12.9	6.8	.6	.7	26.3	2.13	7.18	.28	1.04	.30	1.07	.58	2.11	2.71	9.13	90.87
8-FOOT AND LARGER COMBINES, ILLINOIS, 1935																										
3	1	2	3.4	R	32	5	28.4	2 y	Spl.		9.9	3.2	0.1	0.5	26.2	1.68	5.92	0.06	0.22	0.43	1.61	0.49	1.83	2.17	7.64	92.36
3	2	2	4.3	R	32	5	23.9								22.5	.94	3.93	.09	.37	.39	1.69	.48	2.06	1.42	5.94	94.06
5	1	2	2.9	S	20	5.5	28.1	2 y	Spl., F. m.		11.4	7.2	.4	.7	25.9	1.01	3.59	.37	1.35	.87	3.21	1.24	4.56	2.25	8.01	91.99
5	2	2	3.0	S	20	5.5	33.3								30.6	1.26	3.78	.37	1.16	1.06	3.30	1.43	4.46	2.69	8.08	91.92
17	1	3	3.5	S	30	4.5	25.0	2 y	Spl., dam., F. m.		12.3	1.4	2.0	.7	22.7	2.02	8.08	.09	.39	.18	.78	.27	1.17	2.29	9.16	90.84
17	2	3	3.2	S	30	4.5	20.1								18.7	1.01	5.02	.11	.59	.29	1.50	.40	2.09	1.41	7.01	92.99
10	1	3	2.5	S	28	5	28.7	2 y	Spl.		11.5	1.1	.2	.1	26.0	2.52	8.78	.03	.12	.13	.51	.16	.63	2.68	9.34	90.66
10	2	3	2.4	S	28	3.5	32.9								31.0	1.76	5.35	.04	.12	.15	.48	.19	.60	1.95	5.93	94.07
18	1	3	3.3	S	30	5	36.0	3 y	Moist.		16.0	.9	.2	.2	31.0	2.52	7.00	1.17	3.49	1.28	3.82	2.45	7.31	4.97	13.81	86.19
18	2	3	3.4	S	30	5	29.8								25.9	2.02	6.78	.77	2.77	1.15	4.11	1.92	6.88	3.94	13.22	86.78
13	1	3	2.8	S	24	6	35.4	2 y	Spl.		11.0	3.0	1.1	.1	33.0	2.02	5.71	.06	.16	.28	.85	.34	1.01	2.36	6.67	93.33
13	2	3	3.2	S	24	5	40.6								37.5	2.77	6.82	.05	.14	.27	.72	.32	.86	3.09	7.61	92.39
19	1	3	4.2	R	28	5	15.2	2 y	Spl.		14.1	1.9	.4	.3	13.1	1.21	7.96	.45	3.18	.49	3.52	.94	6.70	2.15	14.14	85.86
19	2	3	3.0	R	28	5	13.7								10.9	1.01	7.37	1.02	8.02	.72	5.66	1.74	13.68	2.75	20.07	79.93
Average			3.2		27	5	27.9				12.3	2.7	.6	.4	25.3	1.70	6.15	.33	1.58	.55	2.27	.88	3.85	2.58	9.76	90.24

5- AND 6-FOOT COMBINES, MISSISSIPPI DELTA, 1935

1	1	3	2.6	S	36	7.5	10.9	2 br	Spl. dam	57.2	8.4	4.0	1.7	0.4	8.4	2.35	21.56	[9] 0.17	[9] 1.96			0.17	1.96	2.52	23.12	76.88
1	2	3	3.6	S	36	7.5	14.8	3 br	Dam	57.5	9.4	3.8	3.2	.3	12.6	2.02	13.65	[9] .13	[9] 1.00			.13	1.00	2.15	14.53	85.47
3	1	2	5.1	S	23	5.2	11.0	2 y	F. m.	57.3	11.1	1.1	.1	1.9	9.6	.90	8.18	.34	3.33	0.14	1.38	.48	4.71	1.38	12.55	87.45
6	1	3	1.4	S	48	9	28.3	2 y	Spl	58.4	12.3	2.8	.2	.2	27.4	.78	2.76	.02	.09	.15	.54	.17	.63	.95	3.36	96.64
7	1	2	2.3	R	42	2.5	12.2	2 bl	Spl., f. m.	57.5	8.7	1.5	.4	1.7	9.8	1.70	13.93	.16	1.57	.59	5.62	.75	7.19	2.45	20.08	79.92
8	1	2	2.8	S	32	8	12.5	3 y	Moist	58.6	16.4	.5	.3	.2	10.8	.93	7.44	.52	4.46	.29	2.53	.81	6.99	1.74	13.92	86.08
9	1	3	2.5	S	34	13	16.8	Samp. y	do	54.6	19.3	.1	.3	6.0	12.3	3.85	22.92	.61	4.70	.07	.57	.68	5.27	4.53	26.96	73.04
10	1	2	2.2	R	37	9.5	8.5	3 y	do																	
									F. m.	55.5	15.4	.2	.4	2.4	6.8	1.61	18.94	.09	1.26	.02	.36	.11	1.62	1.72	20.24	79.76
12	1	2	4.5	S	39	13.5	18.3	3 y	Moist	56.9	15.6	.4	.5	.9	15.6	1.66	9.07	.90	5.39	.10	.62	1.00	6.01	2.66	14.54	85.46
Average			3.0		36	8	14.8			57.1	13.0	1.6	.8	1.6	12.6	1.76	13.16	.33	2.64	.19	1.66	.48	3.93	2.23	16.59	83.41

8-FOOT AND LARGER COMBINES, MISSISSIPPI DELTA, 1935

2	1	3	2.4	R	37	3.5	13.5	3 bl	Spl	58.3	8.9	13.8	0.8	1.9	9.2	2.64	19.56	[9] 1.68	[9] 15.30			1.68	15.30	4.32	32.00	68.00
2	2	3	2.3	R	32	4	8.8	4 bl	F. m.	59.6	7.5	14.6	.6	4.3	6.3	.86	9.77	.10	1.22	1.56	19.72	1.66	20.94	2.52	28.64	71.36
4	1	3	2.2	R	34	4	13.6	2 bl	do	59.0	8.4	.5	1.0	1.9	11.7	1.74	12.79	.05	.41	.09	.73	.14	1.14	1.88	13.82	86.18
5	1	3	2.5	S	49	11	21.4	2 y	Spl	58.0	12.6	4.6	.3	.1	18.5	2.59	12.10	.01	.04	.34	1.81	.35	1.85	2.94	13.74	86.26
11	1	2		S																						
		3	2.0	S	37	8.5	13.1	2 y	Spl., F. m.	56.2	14.6	3.2	.5	1.5	11.5	1.17	8.93	.04	.32	.37	3.06	.41	3.38	1.58	12.06	87.94
Average			2.3		38	6	14.1			58.2	10.4		.6	1.9	11.4	1.80	12.63	.38	3.46	.59	6.33	.85	8.52	2.65	20.05	79.95

5- AND 6-FOOT COMBINES, ILLINOIS, 1936

1	1	2	3.7	R	20	3	15.1	2 y	Spl	56.4	11.2	2.2	1.0	0.3	14.0	0.91	6.03	0.10	0.69	0.04	0.31	0.14	1.00	1.05	6.95	93.05
1	2	2	3.8	R	20	3	17.3								16.6	.50	2.89	.16	.97	.07	.41	.23	1.38	.73	4.22	95.78
2	1	3	4.0	S	21	4	20.4								19.0	1.11	5.44	.09	.05	.21	1.07	.30	1.12	1.41	6.91	93.09
2	2	3	3.7	S	21	4	12.3								10.3	1.41	11.46	.52	4.80	.06	.52	.58	5.32	1.99	16.18	83.82
2	3	3	3.7	S	20	4	18.2	2 y	Spl., t. w.	55.0	14.3	2.5	1.0	.1	16.9	.91	5.00	.34	1.96	.05	.29	.39	2.25	1.30	7.14	92.86
4	1	3	4.2	R	26	4	19.9								18.0	1.51	7.59	.25	1.34	.17	.95	.42	2.29	1.93	9.70	90.30
4	2	3	3.5	R	26	4	24.0	3 y	Dam	56.1	13.1	5.8	3.5	Tr.	21.7	1.76	7.33	.23	1.05	.31	1.39	.54	2.44	2.30	9.58	90.42
8	1	2–3	3.8	S	15	3	15.1	3 y	Moist	54.8	16.25	4.6	1.8	1.3	12.0	2.52	16.69	.42	3.38	.11	.91	.53	4.29	3.05	20.20	79.80
8	2	2–3	3.4	S	15	4	13.8								11.1	2.27	16.45	.35	3.00	.10	.86	.45	3.86	2.72	19.71	80.29
8	3	2–3	3.8	S	19	3	21.8	3 y	Spl	55.3	13.5	10.8	1.7	1.3	19.6	2.02	9.27	.08	.43	.13	.64	.21	1.07	2.23	10.23	89.77
8	4	2–3	4.3	S	19	3	21.3								20.1	1.01	4.74	.13	.62	.10	.51	.23	1.13	1.24	5.82	94.18
9	1	2–3	3.5	S	24	5	27.9	2 y	Spl., dam	55.5	15.0	2.4	2.6	.9	24.0	3.53	12.65	.26	1.06	.11	.45	.37	1.51	3.90	13.98	86.02
9	2	2–3	3.7	S	24	4	26.6								24.3	2.02	7.59	.11	.47	.14	.55	.25	1.02	2.27	8.53	91.47
10	1	2	2.8	S	24	3	31.9	3 y	Spl	55.9	12.85	10.9	.7	.2	29.3	2.52	7.90	.04	.14	.07	.24	.11	.38	2.63	8.24	91.76
10	2	2	2.6	S	24	3	29.9								27.9	1.97	6.59	.02	.06	.04	.16	.06	.22	2.03	6.79	93.21
14	1	3	2.5	R	30	4	37.8	3 y	Spl	56.2	13.15	12.3	.7	.3	33.5	4.28	11.32	.01	.02	.06	.19	.07	.21	4.35	11.51	88.49
14	2	3	2.5	R	30	4	36.7								33.3	3.28	8.94	.02	.06	.07	.22	.09	.28	3.37	9.18	90.82
16	1	2–3	3.6	R	16	5	17.2	4 y	Moist	54.2	16.55	1.7	1.9	.2	14.8	2.01	11.69	.20	1.30	.20	1.30	.40	2.60	2.41	14.01	85.99
16	2	2–3	3.4	R	32	4	37.4	3 y	do	54.9	15.45	4.7	1.6	.8	35.2	1.51	4.04	.33	.93	.40	1.11	.73	2.04	2.24	5.99	94.01

See footnotes at end of table.

TABLE 2.—*Losses in harvesting soybeans with combines of various sizes tested in 1935 and 1936*—Continued

5-AND 6-FOOT COMBINES, ILLINOIS, 1936—Continued

Farm No.	Test No.	Tractor: Plows	Tractor: Speed per hour	Tractor: Tire [1]	Height: Crop	Height: Stubble	Yield (field) per acre [2]	U. S. grade and class [3]	Grade factor [4]	Test weight per bushel	Moisture	Splits	Damage	Foreign material	Yield (bin)[5] per acre	Losses: Harvesting, cutter-bar: Per acre	Losses: Harvesting, cutter-bar: Percent [6]	Losses: Threshing: Straw: Per acre	Losses: Threshing: Straw: Percent [7]	Losses: Threshing: Chaff: Per acre	Losses: Threshing: Chaff: Percent [7]	Losses: Threshing: Total: Per acre	Losses: Threshing: Total: Percent [7]	Losses: Harvesting and threshing: Per acre	Losses: Harvesting and threshing: Percent [8]	Grain saved
		No.	*Miles*		*In.*	*In.*	*Bu.*			*Lbs.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Bu.*	*Bu.*		*Bu.*		*Bu.*		*Bu.*		*Bu.*		*Pct.*
16	3	2–3	3.4	R	32	4	28.0								26.3	1.01	3.61	.22	.80	.45	1.68	.67	2.48	1.68	6.00	94.00
17	1		3.5	R	24	4	18.5	Samp. y	Moist	54.0	18.2	7.7	1.7	.4	14.8	3.17	17.14	.38	2.46	.14	.89	.52	3.35	3.69	19.95	80.05
17	2		3.7	R	24	4	20.3								18.5	1.41	6.95	.29	1.53	.13	.67	.42	2.20	1.83	9.01	90.99
18	1	2	3.3	R	32	4	39.9								36.8	1.76	4.41	.64	1.67	.73	1.90	1.37	3.57	3.13	7.84	92.16
18	2	2	3.5	R	32	5	41.6	3 y	Moist	56.1	15.85	3.0	2.3	.1	38.8	2.27	5.46	.26	.67	.23	.57	.49	1.24	2.76	6.63	93.37
20	1	2–3	3.2	R	30	5	19.0	4 y	do	55.1	16.95	5.9	4.6	.1	16.2	2.02	10.63	.49	2.91	.29	1.71	.78	4.62	2.80	14.74	85.26
20	2	2–3	3.3	R	30	3	21.7								19.3	2.02	9.31	.16	.82	.27	1.35	.43	2.17	2.45	11.29	88.71
Average			3.5		24	4	24.4			55.3	14.8	5.7	1.9	.5	22.0	1.95	8.50	.23	1.28	.18	.80	.41	2.08	2.36	10.40	89.60

8-FOOT AND LARGER COMBINES, ILLINOIS, 1936

Farm No.	Test No.	Tractor: Plows	Tractor: Speed per hour	Tractor: Tire [1]	Height: Crop	Height: Stubble	Yield (field) per acre [2]	U. S. grade and class [3]	Grade factor [4]	Test weight per bushel	Moisture	Splits	Damage	Foreign material	Yield (bin)[5] per acre	Losses: Harvesting, cutter-bar: Per acre	Losses: Harvesting, cutter-bar: Percent [6]	Losses: Threshing: Straw: Per acre	Losses: Threshing: Straw: Percent [7]	Losses: Threshing: Chaff: Per acre	Losses: Threshing: Chaff: Percent [7]	Losses: Threshing: Total: Per acre	Losses: Threshing: Total: Percent [7]	Losses: Harvesting and threshing: Per acre	Losses: Harvesting and threshing: Percent [8]	Grain saved
3	1	2	2.2	S	38	5	37.6	2 y	Spl	57.4	13.0	2.1	0.7	0.4	34.2	3.02	8.03	0.06	0.16	0.32	0.93	0.38	1.09	3.40	9.04	90.96
3	2	2	2.1	S	38	5	35.3								33.6	1.26	3.57	.05	.15	.37	1.08	.42	1.23	1.68	4.76	95.24
5	1	3–5	2.9	R	26	6	27.1	2 y	Spl	56.4	13.25	2.6	1.3	.3	25.7	1.26	4.65	.07	.26	.11	.42	.18	68	1.44	5.31	94.69
5	2	3–5	2.6	R	26	6	37.7								35.4	1.92	5.09	.14	.40	.21	.59	.35	.99	2.27	6.02	93.98
6	1	3–5	2.9	S	26	4	27.3	1 y		56.0	14.05	.1	1.5	.2	25.4	1.01	3.70	.49	1.87	.35	1.32	.84	3.19	1.85	6.78	93.22
6	2	3–5	2.9	S	26	4	30.6	1 y		57.1	12.85	.1	1.4	.1	29.0	1.26	4.12	.18	.61	.14	.48	.32	1.09	1.58	5.16	94.84
7	1	2	3.3	R	22	4	17.6	4 y	Dam	53.5	14.35	.9	6.2	1.2	16.3	1.11	6.31	.07	.42	.15	.93	.22	1.35	1.33	7.56	92.44
7	2	2	3.2	R	22	4	14.5								13.1	1.11	7.66	.08	.60	.22	1.62	.30	2.22	1.41	9.72	90.28
11	1	2	3.1	(10)	22	4	22.7	2 y	T. w.; Spl., dam.	54.8	13.75	5.9	2.2	.4	21.0	.91	4.01	.25	1.16	.50	2.28	.75	3.44	1.66	7.31	92.69
11	2	2	3.5	(10)	22	4	22.0								20.6	.50	2.27	.27	1.23	.58	2.69	.85	3.92	1.35	6.14	93.86
12	1	3	3.0	S	34	3	36.1	2 y	Mottled	57.3	11.9	5.4	2.3	.5	35.0	.50	1.39	.13	.37	.43	1.20	.56	1.56	1.06	2.94	97.06
12	2	3	2.7	S	34	4	33.2								32.0	.50	1.51	.23	.71	.46	1.41	.69	2.12	1.19	3.58	96.42

13	1	2	2.4	S	22	3	44.9	3 y	Moist	55.1	15.25	8.1	2.2	Tr.	43.3	.50	1.11	.21	.46	.89	2.01	1.10	2.47	1.60	3.56	96.44
13	2	2	2.5	S	22	3	39.5								37.1	1.97	4.99	.02	.06	.38	1.01	.40	1.07	2.37	6.00	94.00
15	1	2	3.1	S	23	4	29.9	3 y	Spl.	56.4	12.45	12.0	1.5	.2	28.9	.50	1.68	.27	.91	.19	.66	.46	1.57	.96	3.21	96.79
15	2	2	3.1	S	23	5	37.3								35.3	1.51	4.05	.30	.83	.20	.56	.50	1.39	2.01	5.39	94.61
19	1	3	3.0	S	18	3	25.8	3 y	Moist	55.2	15.6	1.7	2.6	.2	23.7	1.46	5.66	.24	.99	.38	1.55	.62	2.54	2.08	8.06	91.94
19	2	3	3.0	S	18	3	24.4								22.8	1.26	5.16	.17	.72	.20	.86	.37	1.58	1.63	6.68	93.32
19	3	3	1.9	S	29	4	51.1	3 y	Moist. Dam.	56.5	15.7	.8	3.8	.2	48.6	1.06	2.07	.52	1.04	.90	1.80	1.42	2.84	2.48	4.85	95.15
19	4	3	2.5	S	29	5	46.7								43.2	2.07	4.43	.40	.90	1.05	2.34	1.45	3.24	3.52	7.54	92.46
21	1	2–3	4.4	R	30	4	24.4	4 y	Moist. Dam.	52.5	17.95	1.0	7.0	.1	22.5	.76	3.11	.27	1.16	.90	3.78	1.17	4.94	1.93	7.91	92.09
21	2	2–3	4.0	R	30	4	27.0								25.1	.86	3.19	.25	.95	.82	3.14	1.07	4.09	1.93	7.15	92.85
22	1	2–3	1.8	R	36	5	29.5	3 y	Moist	54.8	16.25	4.2	2.0	.3	27.8	.86	2.92	.32	1.10	.50	1.73	.82	2.83	1.68	5.69	94.31
22	2	2–3	2.1	R	36	5	33.0								31.0	1.01	3.06	.34	1.06	.62	1.94	.96	3.00	1.97	5.97	94.03
Average			2.8		27	4	31.5			55.6	14.33	3.4	2.7	.3	29.6	1.18	3.91	.22	.76	.45	1.51	.67	2.27	1.85	6.10	93.90

5- AND 6-FOOT COMBINES, MISSISSIPPI DELTA, 1936

1	1	3	2.8	R	40	12	22.2	4 y	Moist	56.5	16.8	6.8	0.7	0.3	19.0	2.63	11.84	.26	1.33	0.27	1.41	0.53	2.74	3.16	14.25	85.75
2	1	3	2.8	S	46	10	23.1	2 y	Spl.	57.2	14.1	2.2	.5	.3	21.2	1.72	7.43	.01	.03	.16	.73	.17	.76	1.89	8.14	91.86
3	1	2	2.0	S	40	5	18.0	2 y	do	57.1	14.5	4.3	.3	.5	16.9	.77	4.29	.10	.59	.22	1.26	.32	1.85	1.09	6.06	93.94
4	1	3	3.8	S	40	5	17.5	2 y	do	57.2	13.8	2.3	.2	.2	16.2	1.07	6.11	.06	.36	.17	1.05	.23	1.41	1.30	7.43	92.57
5	1	3	3.4	S	30	4	16.7	2 y	Spl., F. m.	56.5	13.9	1.1	.6	1.4	15.1	.06	.39	1.19	7.15	.32	1.93	1.51	9.08	1.57	9.42	90.58
5	2	3	3.3	S	29	5		3 y	F. m.	57.6	13.5	4.6	.9	3.0	20.9			.28	1.33	.08	.37	.36	1.70			
6	1	3	2.3	S	38	11	12.8	2 y	Spl., F. m.	57.0	14.4	9.5	2.2	1.1	11.1	1.50	11.71	.12	1.06	.09	.83	.21	1.89	1.71	13.38	86.62
7	1	2	2.4	S	30	9	21.2	2 y	Spl.	56.5	13.0	10.0	.9	.6	19.4	1.64	7.74	.07	.37	.10	.50	.17	.87	1.81	8.56	91.44
Average			2.8		37	8	18.8			56.9	14.2	5.1	.8	.9	17.5	1.34	7.07	.26	1.53	.18	1.01	.44	2.54	1.79	9.61	90.39

[1] R=rubber, S=steel.
[2] Bin yield plus all losses.
[3] Y=yellow; Br.=brown; Bl.=black; Samp.=sample.
[4] Spl.=splits; F. m.= foreign material; Dam.=damaged; Moist.=moisture; T. w.=test weight.
[5] Net grain saved.
[6] Based on field yield.
[7] Based on bin yield plus threshing losses.
[8] Based on field yield and all losses per acre.
[9] Straw and chaff.
[10] Front, steel; rear, rubber.

WHEAT AND OAT LOSSES

In harvesting wheat and oats with a combine, low hanging heads either may be missed by the cutter bar or the stems are cut and the heads fall to the ground in front of the machine. Heads may also hang on reel slats and be thrown to the ground in front of or behind the platform. The reel may also shatter some grain. Some losses of this character are common to all types of grain harvesters. Others, however, could be eliminated or reduced by adjustments or changes in the design of the combine, header, and reel, or by the use of special guards. A determination of the cause of cutter-bar losses was beyond the scope of the field work on which this report is based. Neither shattering prior to harvest nor that caused by the reel was apparent in wheat and oat fields where tests were made. For this reason the cutter-bar loss as shown for these crops is made up almost entirely of grain heads on the ground which were for the most part cut by the sickle but not deposited on the canvas.

The causes of cutter-bar losses are largely apparent from the driver's seat; those of threshing losses, however, are not. Hence, when the latter losses occur they frequently may continue unchecked so long as the grain stream continues to flow into the bin. The experienced operator is always mindful of change either in weather or in crop conditions and, when changes occur, checks the quality of the work done. Simple adjustments may result in a worth-while saving of grain. There are adjustments on all combines now on the market to meet a wide range in threshing conditions, attention to which will normally result in negligible grain loss. This is borne out in the accompanying data in which many individual tests show only a slight loss. Such results are not possible in every case, because of variation in field, crops, and weather conditions under which combines were operated, and because of lack of experience on the part of some operators.

Losses in small grain for the 1935 season were considerably higher than for the 1936 season regardless of size of combine. Table 1 shows that in 1935, in terms of grain saved, about 90 percent of the wheat crop and 81 percent of the oat crop were saved in combining in the fields where tests were made. In 1936 about 97 percent of the wheat and 95 percent of the oats were saved on such fields. The two seasons are representative of extremes under which combines function, and it is apparent that machine efficiencies will vary with variation in crop and field conditions. This applies to threshing loss as well as cutter-bar loss. In harvesting lodged fields, for example, the cutter bar is run low so as to cut as much of the crop as possible, and in so doing long straw and green weeds are fed into the machine in a tangled mass giving rise to abnormal threshing and separating conditions. The tangled grain resists threshing action of the cylinder and the strong wind blast necessary to dispose of the heavy chaff and weeds on the sieves blows out some of the threshed grain.

The results given in table 1 show that harvesting and threshing losses apparently are not related to the size of combine, except possibly with oats where the difference is over 1 percent. In the case of wheat the extreme difference is only 0.4 percent. In 1936 cutter-bar losses in wheat were practically the same for each size of machine. The threshing loss of the larger combines, although relatively low (1.40

percent) was twice that of the smaller machines. In 1935 cutter-bar losses (5.92 percent) with the small combines were about 1.5 percent higher and threshing losses (3.67 percent) about 1 percent lower than with the larger machines.

General interpretation of the data indicates that in combining wheat in favorable seasons the small combines do as well as the larger ones in harvesting and are superior to them in threshing; in unfavorable seasons the harvesting loss with the small combines is higher and the threshing loss is lower than when the larger machines are used. This relationship is borne out with oats harvested in 1936. The higher threshing efficiency with the small machines is doubtless due to greater threshing and separating capacity per foot width of cut, and the comparatively high harvest loss under adverse conditions is doubtless because of cumulative loss resulting from use of a comparatively short cutter bar. The lack of an additional operator for the header on small combines may also have some effect on cutter-bar losses.

The distribution of cutter-bar losses for wheat and oats is shown in figure 8 for the 5- or 6-foot machines and those of larger sizes.

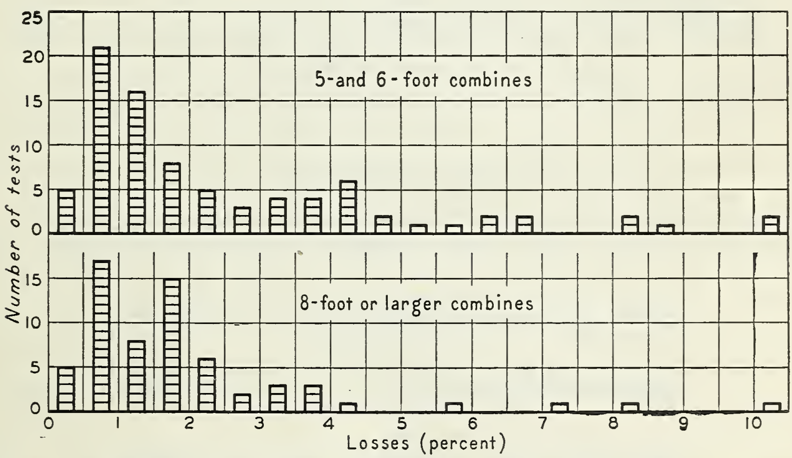

FIGURE 8.—Distribution of cutter-bar losses of 5- and 6-foot combines and 8-foot or larger sizes in harvesting wheat and oats.

In approximately 59 percent of the tests cutter-bar losses were below 2 percent for the small machines. For the 8-foot and larger sizes such losses were below 2 percent in about 70 percent of the tests. For these tests with cutter-bar losses falling below 2 percent about half were below 1 percent for each size group.

Figure 9 shows the distribution of threshing losses for the two size groups of combines. In about 72 percent of the tests threshing losses were below 2 percent, and in over 50 percent of the tests below 1 percent for the 5- or 6-foot combines. For the 8-foot and larger sizes threshing losses were below 2 percent in about 58 percent of tests and below 1 percent in about 28 percent of the tests.

The relative importance of cutter-bar and thresher losses for the two size groups of combines in harvesting wheat and oats is shown in figure 10. In harvesting wheat cutter-bar losses constituted by far the larger proportion of the total loss. For the 5- and 6-foot machines

this represented about 66 percent of the total, and for the 8-foot and larger sizes about 51 percent of the total.

In threshing wheat with small machines about 24 percent of the total loss was represented by threshed grain in the chaff and about

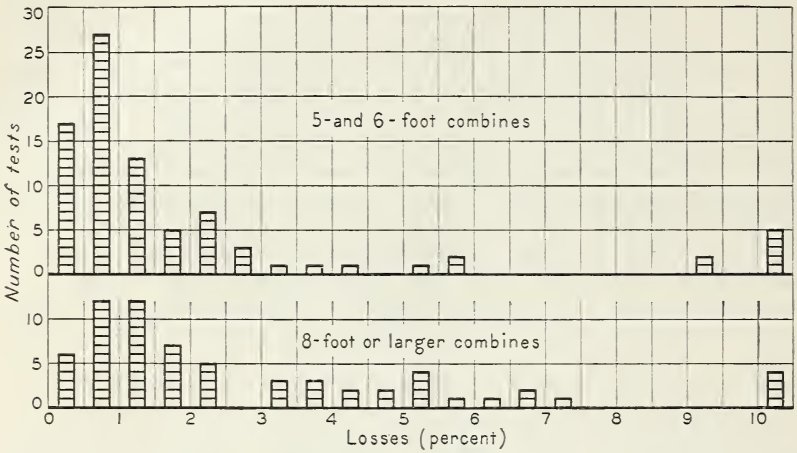

FIGURE 9.—Distribution of threshing losses of 5- and 6-foot combines and 8-foot or larger sizes in harvesting wheat and oats.

10.5 percent of the total by unthreshed grain in the straw. For the 8-foot and larger sizes about 39 percent of the total loss was due to threshed wheat thrown out with the chaff and about 10 percent to unthreshed grain. The small machines lost proportionally less

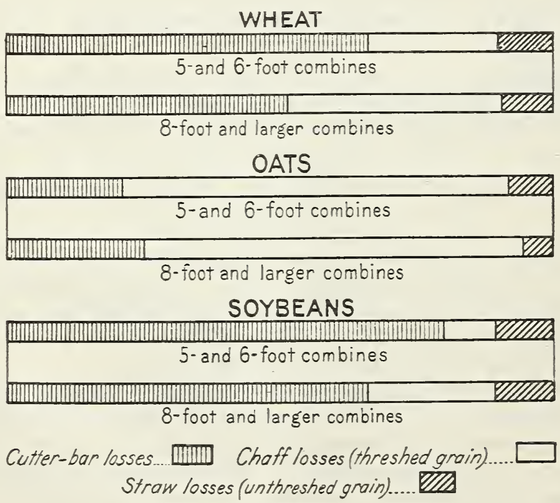

FIGURE 10.—Proportion of cutter-bar, chaff, and straw losses for 5- and 6-foot combines and those of larger sizes in harvesting wheat, oats, and soybeans.

threshed wheat than the larger ones and only slightly more unthreshed wheat, but as seen in the paragraph next preceding, cutter-bar losses were proportionally higher than for the 8-foot and larger sizes.

In harvesting oats with 5- and 6-foot machines, 21 percent of the total loss was represented by cutter-bar losses; and for the 8-foot and larger sizes cutter-bar losses constituted 25 percent of the total. Threshed oats thrown out with the straw and chaff represent 70 and 69 percent of the total losses by the small and the large machines, respectively. Unthreshed oats constituted 9 percent of the total loss in the case of the small machines and 6 percent for the other size group. In oats the proportionately high loss of threshed grain, shown in the chart, emphasizes the importance of careful adjustment in the separating unit of the machine.

Under favorable conditions both cutter-bar and threshing losses for a combine are small in bushels per acre, as is shown in table 1. Even under unfavorable conditions losses from combining are usually lower than for any other type of grain harvesting and threshing equipment. Efforts to reduce losses however, should be directed towards more effective operation of the header, particularly when harvesting wheat with either small or large machines. The increased separating capacity per foot width of cut in the small machines operating in wheat is reflected in less threshed grain thrown out with the straw or chaff than for the 8-foot and larger sizes. In oats, as might be expected, the higher loss is threshed grain thrown out with the chaff and straw. Oats are difficult to clean because of their light weight. A blast of air sufficiently strong to remove foreign material will invariably blow out a considerable quantity of the threshed grain.

SOYBEAN LOSSES

Soybean losses, because of the effect of adverse fall weather on both field and crop, are generally higher than those of small grain. Expressed in terms of crop saved in combining, this amounted to from 90 to 94 percent in Illinois (table 2) and 80 to 90 percent in the Mississippi Delta. In 1935, in Illinois, the saving was practically the same for the two sizes of machine, with greater cutter-bar loss and less threshing loss for the smaller machines. In 1936, in Illinois, there was a difference of over 4 percent in saving in favor of the large machines, practically all of the difference being attributable to the cutter-bar loss. In the South, where soybeans are planted in rows, the 1935 harvest data based on a limited number of tests show that the small combines effected a saving of 3.5 percent over the large machines; and in the 1936 Mississippi Delta harvest they were practically as efficient as those in Illinois for 1935 and 1936. Although considerable variation exists in the ultimate saving of the crop and in comparable efficiencies by size of machine, the data show for soybeans as for small grain, that cutter-bar losses of the small machines are comparatively higher and threshing losses lower than those of the large machines.

Soybean cutter-bar losses may be due to a number of causes, some of which are not directly attributable to lack of proper machine adjustment, at least with the present equipment. Whole plants are sometimes thrown out by the reel, or when plants are leaning badly they may be cut off and dropped in front of or to the side of the platform. Careless operation or field irregularities may cause the cutter-bar to miss some of the lower bean pods; the reel may strike the plants and shatter out some of the beans or knock off some of the

pods; and of course when the plants are badly lodged, many of them cannot be recovered. The lack of an additional operator for the header on small combines may have some effect on cutter-bar losses. There is also a tendency on the part of some farmers to try out the new machine under adverse crop and field conditions. An appreciable number of plants, parts of plants, or pods left on the field may represent quite a serious loss of beans.

Soybean cutter-bar losses (fig. 11) for the 5- and 6-foot combines

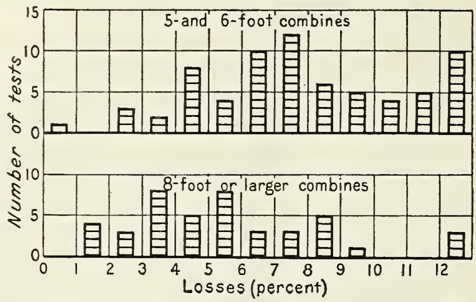

FIGURE 11.—Distribution of cutter-bar losses of 5- or 6-foot combines and 8-foot and larger sizes in harvesting soybeans.

ranged from less than 2 to over 12 percent, with 20 percent of the total number of machines incurring less than 5 percent loss. With nearly 50 percent of the larger combines this loss was under 5 percent.

In the Mississippi Delta, where soybeans are almost universally planted on ridged rows, cutter-bar losses were considerably heavier than in Illinois, where the beans are generally drilled or broadcast on a level seedbed. Exclusion of the machine losses in the Delta would lower the average percent loss one group for the 5- and 6-foot and two groups for the 8-foot and larger combines.

The threshing losses for soybeans (fig. 12) show a fairly close corre-

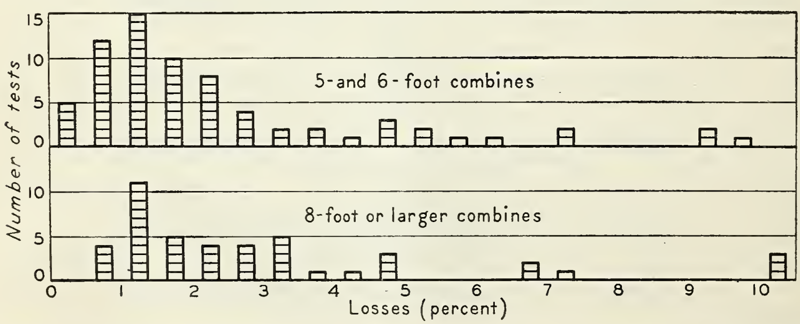

FIGURE 12.—Distribution of threshing losses for 5- and 6-foot combines and 8-foot or larger sizes in harvesting soybeans.

lation for the two sizes of combines. The largest concentration for each size is in the group 1.0–1.4 percent. While a few combines are found in the groups representing higher losses, about 77 percent of all machines regardless of size are found in the groups under 3.5 percent. Fifty-nine percent of the 5- and 6-foot and 45 percent of the 8-foot and larger combines showed losses through the machine of less than 2 percent.

The relative importance of cutter-bar and threshing losses for the two sizes of combines in harvesting soybeans is shown in figure 10. Of the total loss sustained in harvesting and threshing with the 5- and 6-foot combines 80 percent is chargeable to cutter-bar, 9 percent to separating unit, and 11 percent to cylinder because of unthreshed pods. For the 8-foot and larger combines the cutter-bar loss is 66 percent, separating loss 23 percent, and cylinder loss 11 percent.

As in wheat, cutter-bar losses are by far the more serious ones and the problem is greater with the small machines. Carrying the analogy farther, the loss of unthreshed beans from the chaffer is proportionately higher with the large combines. Loss due to unthreshed pods is practically the same proportion of total loss for each size of machine and follows rather closely the characteristic performance in threshing wheat.

RATE OF TRAVEL

In harvesting wheat and oats during the 1935 and 1936 seasons the 5- and 6-foot combines were usually pulled at 0.5 to 1 mile per hour

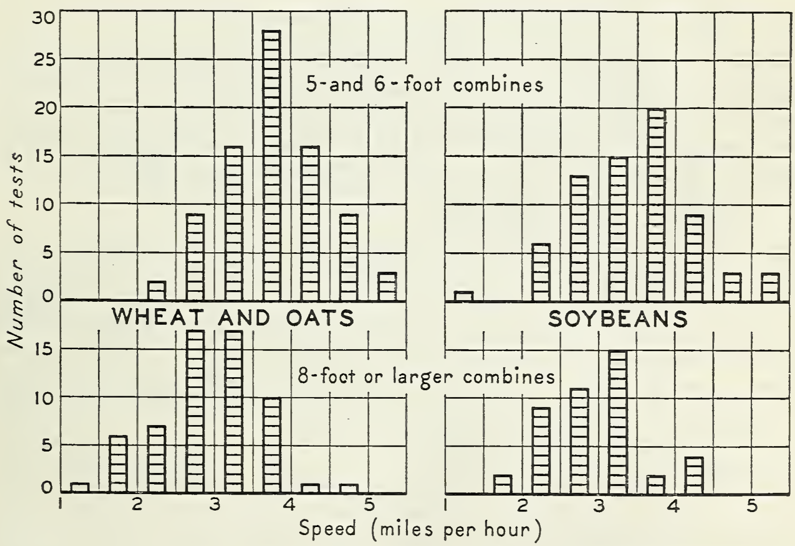

FIGURE 13.—Distribution of ground speed of 5- and 6-foot combines and 8-foot and larger sizes in harvesting wheat and oats and soybeans.

faster than those of larger sizes. High ground speed is, of course, made possible by rubber tires but is limited by the type and mechanical condition of the tractor used, and crop and field conditions. Many of the small machines were operated by tractors not capable of a 5-mile-per-hour gait. In fields where the crop was lodged, exceptionally rank, or infested with weeds, slow ground speed was necessary for effective threshing and cleaning operations. In areas where it is customary to "disk in" wheat or oats following corn the ground was frequently too rough for high speed.

A comparison of the ground speed of the 5- and 6-foot machines with those of larger sizes is made in figure 13. Approximately 67 percent of the small machines were operated at 3.5 miles per hour, or faster,

in harvesting wheat and oats whereas only about 20 percent of the larger ones fell within this range. With the exception of machines operating under adverse field and crop conditions the small combines were as effective in cutting, threshing, and cleaning wheat and oats when traveling at 5 miles per hour as at lower speeds.

In combining soybeans a ground speed of 3.5 to 3.9 miles per hour was most used by operators of the 5- and 6-foot combines, and the larger machines were operated an average of 0.5 mile per hour slower. About one-fifth of the small machines and one-seventh of the large machines were operated above these respective speeds, six of the former operating from 4.5 to over 5 miles per hour. In harvesting soybeans high ground speed is frequently not so important as in wheat and oats, especially as soft wet ground and lodged fields are frequently encountered. With a heavy mass of material going through the machine greater efficiency results from normal to slow ground speed. The range in speed from 2 to over 4 miles per hour for the majority of the small combines reflects in part variation in field and crop conditions incident to harvest.

EFFECTIVE CUTTING WIDTH

Careful driving of the tractor is necessary in cutting a full swath of drilled or broadcast grain with any size combine. In harvesting wheat and oats in Illinois and Indiana the 5- and 6-foot machines as tested cut a swath approximately 95 percent as wide as the cutting width of the machine. The actual cutting width of the 8-, 10-, 12-, and 16-foot combine tested ranged from approximately 91 to 94 percent of the cutter-bar length.

With some combines it is possible to cut a swath wider than the width of cut specified by the manufacturer. In such cases the point of the divider boards extends beyond the end of the sickle. Thus by crowding the machine into the uncut grain a swath several inches wider than the length of the sickle (point of outer guard to point of inner guard) may be cut. Several machines tested were found operating in this manner showing an effective cutting width somewhat wider than the size of the machine would indicate.

Soybeans are customarily drilled or broadcast in Illinois, and in the Mississippi Delta they are almost universally planted in 36- to 42-inch rows for cultivation. In the former case the width of swath taken by the cutter bar of the combine is comparable to that of small grain. With row-planted crops, however, the effective width of cut may vary as much as 100 percent depending upon the row width and the number of rows cut. For example, with 42-inch rows the effective width of cut for one row is 3.5 feet, but when two rows are cut simultaneously the effective width of cut is 7 feet although the actual length of cutter bar may be only 5 feet.

The data show that the effective width of cut for the 5- and 6-foot machines in the Mississippi Delta was 100 percent of the length of the cutter bar, and for the 8-foot and larger combines 96 percent of the length of cutter bar. The necessity for care in the manipulation of the header increases with the number of rows cut simultaneously, and owing to unevenness of ground, relative cutter-bar losses are likewise apt to be higher.

In Illinois the effective width of cut was 97 percent for the 5- and 6-foot combines and 94 percent for the 8-foot and larger sizes.

QUALITY OF GRAIN

Crops such as wheat, oats, and soybeans are usually sold on the market by grade and class designation. There are five commercial grades of wheat and four each for oats and soybeans. The difference in price between any two grades of a given class is usually sufficient to justify care in the operation of a combine in order to obtain the highest possible grade.

Grading factors largely under the control of the combine operator are foreign material other than grain, machine damage, moisture content, and, in the case of soybeans, splits. During July and August 1935 and 1936 the average daily difference in price for each month between grades of soft red winter wheat on the St. Louis market ranged from 0.1 to 4.6 cents per bushel (table 3). For white oats on the Chicago market during July and August of the same seasons this range was from 0.7 to 3.0 cents per bushel and for yellow soybeans during the period from October 15 to November 15 ranged from 0.3 to 4.4 cents per bushel.

TABLE 3.—*Average daily price difference per bushel for a period of 1 month between grades of wheat, oats, and soybeans in carlots for cash transaction at certain terminal markets during the 1935 and 1936 harvest seasons*

Period	Price difference between—					
	Nos. 1 and 2	Nos. 2 and 3	Nos. 3 and 4	Nos. 4 and 5	No. 4 and sample	No. 5 and sample
SOFT RED WINTER WHEAT, ST. LOUIS [1]						
	Cents	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*
July 1935	0.1	1.7	1.8	1.7		1.6
August 1935		2.3	1.7	2.4		4.6
July 1936	1.4	1.5	.5	2.1		4.1
August 1936	1.0	2.0	2.0			
WHITE OATS, CHICAGO [2]						
August 1935	2.5	2.5	1.3		1.9	
September 1935		2.4	3.0		1.2	
August 1936	.7	1.2	1.6		2.9	
September 1936	.9	1.6	1.4		.9	
YELLOW SOYBEANS, CHICAGO [3]						
Oct. 15 to Nov. 14, 1935		0.6	0.6		2.3	
Nov. 15 to Dec. 14, 1935		1.7	1.7		3.0	
Oct. 15 to Nov. 14, 1936	0.3	1.0	2.5		2.3	
Nov. 15 to Dec. 14, 1936	.3	.9	1.5		4.4	

[1] Based on weighted average prices per bushel by grades as compiled by the Bureau of Agricultural Economics from the St. Louis daily market record—5,604 cars.
[2] Based on weighted average prices per bushel by grades as compiled by the Bureau of Agricultural Economics from the Chicago Daily Trade Bulletin—4,709 cars.
[3] Based on weighted average prices per bushel by grades compiled from the Chicago Daily Trade Bulletin—1,565 cars.

Complete analysis of samples of wheat and oats obtained in field studies of combines during the 1935 season was not made but observations indicated that size of combine made no difference in quality of grain obtained. Rains during the harvest season and green weeds and weed seed accounted for a high moisture content of some samples.

Complete analysis of 18 samples of wheat and 15 samples of oats obtained in Illinois in 1936 showed no effect of size of machine on quality of grain obtained. Eleven of the wheat samples graded No. 1 and the remainder No. 2. All of the No. 2 wheat samples were graded off because the test weight fell below 60 pounds per bushel. Test weight also accounted for all samples of oats obtained in Illinois and graded below a No. 1.

One of five samples of wheat obtained in Indiana was graded off because of machine damage but adjustments corrected this trouble. Low test weight accounted for all samples of oats obtained in Indiana which were graded below No. 1. Four of the 14 samples were graded No. 1, 3 No. 2, 3 No. 3, and 4 No. 4.

In 4 of the 13 samples of wheat obtained from 5- or 6-foot combines in Ohio foreign material (matter except other grain) was a grading factor. One of the samples contained 0.8, two 0.9, and one 1.2 percent of matter except other grain. Such quantities of foreign material were not noticeable in sampling, consequently no attempt was made to adjust the machine for better cleaning. In one of the four cases the test weight was below that required for a No. 1 wheat. Low test weight accounted for all samples graded below No. 1 obtained from 8-foot and larger machines in Ohio.

Analysis of samples of soybeans obtained in Illinois and in the Mississippi Delta in 1935 favored the large machines in the former area and the small ones in the latter area. There was, however, considerable difference in the concave adjustment of the small combines in the two areas. In the South the soybean plants were generally large and tough, and to handle the bulky material efficiently it was customary to remove the concaves. As a result fewer beans were split in the process of threshing than in Illinois where the small machines were operated with the concave in place and threshing was done at a slightly higher cylinder speed. Several small machines operating in Mississippi in 1935 split less than 1 percent of the beans and a satisfactory job of threshing was obtained. In Illinois the range in split beans was from 1.5 to 18 percent in 1935, with only a few samples above 10 percent, the maximum allowed for U. S. No. 2.

Six of the eight samples obtained in the South in 1936 graded U. S. No. 2, one U. S. No. 3, and one U. S. No. 4, The No. 3 sample was graded off because of foreign material, and the U. S. No. 4 was graded off because of excessive moisture content. Of the 26 samples obtained in Illinois in 1936, 2 were graded U. S. No. 1; 7 U. S. No. 2; 12 U. S. No. 3; 4 U. S. No. 4; and 1 U. S. Sample grade. The majority of the U. S. No. 3 grade samples were graded off because of excessive moisture, though splits or damage accounted for 5 of the 12 samples. Three of the U. S. No. 4 samples were graded off because of excessive moisture and one because of damage.

Variations in splits in samples of beans obtained from large and small combines may have been due in part to differences in cleaning facilities. Some of the large machines have recleaners or rotary weed screens not commonly found on the 5- and 6-foot combines tested. In some cases 8-foot and larger sizes may have split as many beans as the small ones and removed the particles of broken beans before they reached the grain bin.

MACHINE ADJUSTMENTS

Variations in crop, weather, and field conditions greatly affect machine performance in harvesting and threshing. Due to the wide variety of conditions encountered, no set of rules for machine adjustments will apply in all cases. However, as the operator becomes familiar with his combine, adjustments can usually be made which will insure satisfactory performance for most conditions as they may arise. For this reason it is important that the combine operator become thoroughly familiar with his machine.

If the combine is purchased new much can be learned as to the design, construction, and means of adjustment by assisting the dealer in setting up the machine. If this is done and a careful study of the instruction book made much time, labor, and expense may be saved.

In making field tests of combines no attempt was made to service the various machines. However, adjustments were recommended when losses appeared high and were followed in most cases by the combine operator. The effects of some adjustments are shown in table 4.

Adjustments were frequently made on the combine to reduce the quantity of threshed grain thrown out from the straw and chaff. In some instances, as for example on farms Nos. 3, 4, in Ohio and No. 19, in Illinois, the reduction in losses due to adjustments are not significant. On farm No. 11 in Illinois a sieve adjustment reduced the quantity of threshed grain thrown out with the chaff from 2.20 to 0.29 bushels per acre. With wheat at $1 per bushel the saving amounted to $1.91 per acre.

The effect of ground speed on threshing losses is illustrated in tests on farm No. 25, in Ohio; No. 23 in Illinois in 1936, and farms Nos. 11 and 12 in Illinois in 1935. On farm No. 25 it is doubtful whether the reduction in ground speed from 4.2 to 3.1 miles per hour was advisable in order to save only 0.09 bushel of wheat per acre. The crop was dry and not weedy. If the crop had been rank, weedy, or damp the quantity of grain saved resulting from the reduction in ground speed would doubtless have been much greater.

If the surface of the ground is smooth, the tractor is capable of traveling at high speed, and the combine has a cutting, threshing, and separating capacity for handling the crop, high ground speed may be advisable. On Ohio farm No. 7, for example, machine losses were a little less at a speed of 4.8 than at 3.7 miles per hour. Practically the same was true of farm No. 1 in Mississippi, and No. 23 in Illinois. When the crop is light, machine losses may be less at high than at low speed.

On Illinois farm No. 12 the oat crop was badly lodged and weedy. Weeds covered the chaffer, resulting in a heavy loss of threshed grain thrown out with the chaff. Under such test conditions a reduction in ground speed from 4.5 to 2.4 miles per hour gave the machine more time to handle this bulky material, resulting in a reduction in loss of threshed grain from 16.11 to 9.67 bushels per acre. A further reduction in ground speed or width of swath probably would have again reduced the machine losses. A much higher percentage of the crop was being saved by the combine than by any other method except possibly the use of a mower and windrow pick-up attachment.

TABLE 4.—*Effect of machine adjustment on combine threshing losses, tests of 1935 and 1936*

Farm No.	Test No.	Tractor			Crop				Threshing losses						Remarks
		Plows	Tire [1]	Speed per hour	Kind	Yield per acre (field) [2]	Height		Straw		Chaff		Total		
							Crop	Stubble	Per acre	Per-cent [3]	Per acre	Per-cent [3]	Per acre	Per-cent [3]	
		Number		*Miles*		*Bushels*	*Inches*	*Inches*	*Bushels*		*Bushels*		*Bushels*		
ILLINOIS, 1935															
11	1	3	R	3.4	Oats	51.1	38	16	0.66	1.36	12.80	26.22	13.46	27.58	Heavy lodged straw. Many green weeds in field. Green material in tank.
	2			2.7		34.2	36	13	.71	2.26	2.94	9.39	3.65	11.65	Speed reduced—better cleaning job and more grain saved.
12	1	2	R	4.5	do	50.2	28	9	.69	1.42	16.11	32.96	16.80	34.38	Crop badly lodged and weedy.
	2			2.4		53.2	27	5	.71	1.37	9.67	18.57	10.38	19.94	Ran slower than for test 12-1.
MISSISSIPPI, 1935															
1	1	3	S	2.6	Soybeans	10.9	36	8					0.17	1.96	
	2			3.6		14.7	36	8					.13	1.00	Increased ground speed.
OHIO, 1936															
3	1	2	S	3.9	Wheat	33.5	42	12	0.02	0.05	0.14	0.45	0.16	0.50	
	2			3.8		28.4	40	10	.02	.06	.08	.31	.10	.37	Raised chaffer extension slightly to lessen shoe losses.
4	1	2	S	3.6	do	25.1	32	9	.02	.07	.17	.69	.19	.76	Tailboard down 3 inches.
	2			3.8		20.7	31	9	.05	.23	.03	.16	.08	.39	Tail rake raised 20°; tailboard raised to rake; wind closed 15 percent; tap sieve three-fourths open.
7	1	2	S	3.7	do	26.4	32	16	.10	.39	.13	.51	.23	.90	Concaves down; wind full; tailboard 3 inches below rake.
	2			4.8		23.0	32	12	.03	.15	.12	.52	.15	.67	Concaves raised 5 notches; tailboard raised; wind reduced.
25	1	2	R	4.2	do	32.8	35	9	.01	.04	.24	.76	.25	.80	Tractor in third gear.
	2			3.5		29.5	35	9	.01	.30	.15	.54	.16	.57	Tractor in second gear.
	3			3.1		30.6	35	10	.01	.03	.15	.51	.16	.54	Tractor in first gear.
18	1	2	S	3.1	do	35.2	42	17	.02	.05	.33	.94	.35	.99	
	2			3.1		38.3	42	17	.02	.04	.32	.83	.34	.87	Lowered concaves to last notch to lessen rack loss.
24	1	2	R	3.5	do	19.7	33	15	.01	.03	.11	.58	.12	.61	
	2			3.5		14.3	33	15	.01	.06	.07	.52	.08	.58	Dropped concaves in attempt to stop shoe loss.

ILLINOIS, 1936

8	1	2	S	3.5	Wheat	39.9	35	22	0.04	0.12	0.76	1.91	0.80	2.03	Grain slightly green.
	2			3.1		39.5	33	22	.04	.11	.34	.88	.38	.99	Grain riper than test 8-1.
11	1	2-3	S	3.1	do	38.3	39	21	.04	.11	2.20	5.82	2.24	5.93	Heavy crop flooded sieves.
	2			3.0		37.7	37	18	.04	.11	.29	.77	.33	.88	Opened sieves.
23	1	3-5	S	2.0	do	28.4	25	11	.01	.03	.04	.16	.05	.19	Slow ground speed.
	2			3.4		23.9	24	12	.00	.01	.03	.13	.03	.14	Faster ground speed than 23-1.
19	1	2	S	2.9	Oats	32.3	23	8	.02	.07	.82	2.55	.84	2.62	
	2			3.4		26.8	24	7	.05	.20	.49	1.84	.54	2.04	Closed wind down some.
26	1	3-4	S	2.8	do	56.1	23	6	.04	.07	1.72	3.11	1.76	3.18	
	2			3.9		45.5	23	6	.13	.30	1.70	3.81	1.83	4.11	Opened top sieve slightly; reduced wind directing it more to front of sieves than for test 26-1.
	3			------		43.2	23	5	.03	.06	.53	1.33	.56	1.39	Found 1 section of straw rack clogged. Raised cylinder speed from 950 to 1,000 r. p. m. and ran test as of adjustment for 26-2.
27	1	3-4	S	2.7	do	31.3	27	7	.15	.49	6.84	22.29	6.99	22.78	
	2			2.8		36.2	30	9	.11	.31	1.64	4.61	1.75	4.92	Reduced and redirected wind; adjusted recleaner for more even distribution.
29	1	2-3	S	4.5	do	33.6	27	10	.14	.44	1.63	4.99	1.77	5.43	Section broken from lower shoe sieve causing recleaner loading. Green material in tank clipped from weeds.
	2			3.1		34.7	26	12	.10	.29	1.33	3.93	1.43	4.22	Air blast reduced; ground speed slower.
31	1	3	S	3.2	do	42.3	31	5	.19	.45	6.68	16.08	6.87	16.53	
	2			3.2		44.2	29	10	.12	.27	5.66	13.35	5.78	13.62	Opened sieve in lower shoe; raised rear end of sieve and tailboard; reduced blast on lower shoe; readjusted recleaner for better distribution.
	3			2.2		36.9	31	12	.05	.13	.48	1.30	.53	1.43	Ran slower at same adjustment as for test 31-2.
21	1	2-3	R	4.4	Soybeans	24.4	30	4	.27	1.16	.90	3.78	1.17	4.94	Beans very tough and damp.
	2			4.0		27.0	30	4	.25	.95	.82	3.14	1.07	4.09	Opened top sieve of shoe; wind blast directed more to front of shoe.

INDIANA, 1936

16	1	2	S	2.3	Oats	39.6	27	10	0.11	0.27	2.59	6.57	2.70	6.84	
	2			2.3		42.9	27	10	.11	.27	.50	1.18	.61	1.45	Closed down recleaner sieve; raised recleaner tailboard.

MISSISSIPPI, 1936

5	1	3	S	3.4	Soybeans	16.7	30	4	1.19	7.15	0.32	1.93	1.51	9.08	
	2			3.3		-------	29	5	.28	1.33	.08	.37	.36	1.70	Increased cylinder speed 25 percent. Loss of 1 grade because of added foreign matter.

[1] R=rubber. S=steel.

[2] Based on bin yield plus all losses.

[3] Based on bin yield plus threshing losses.

On Ohio farm No. 7 some grain was being left in the heads. Raising the concaves greatly reduced this loss but resulted in heavier loading of the chaffer due to an increase in the quantity of chopped or broken straw. Wind and tailboard adjustments, however, corrected this.

On Ohio farm No. 24 the quantity of threshed grain thrown out with the chaff and straw seemed somewhat high in view of the low yield. Lowering the concaves resulted in less chopped straw and consequently a reduction in sieve losses. Had the crop been heavy or tough such an adjustment probably would have increased the loss of unthreshed grain.

On Mississippi farm No. 5 a considerable quantity of beans was passing through the machine unthreshed. An increase in cylinder speed of about 25 percent reduced this loss from 1.19 to 0.28 bushels per acre. However, this increase in cylinder speed increased the quantity of foreign material in the soybeans sufficiently to reduce the market grade. The increase in foreign material was not noticed in sampling and no attempt was made to adjust the separator. An increase in air blast or a sieve adjustment would doubtless have reduced the excess quantity of foreign material carried over with the threshed soybeans.

SUMMARY

During 1935 and 1936 there were approximately 10,000 5- and 6-foot combines manufactured, the greater portion of which were sold in the Corn and Winter Wheat Belts.

The different makes of small combines upon which tests were made were similar in that pneumatic tires were used, and the threshing and cleaning capacity is larger per foot of cutter-bar width than in other machines, making possible a higher ground speed.

In small grain the 5- and 6-foot combines were usually pulled from 0.5 to 1.0 mile per hour faster than the larger sizes; in soybeans an average of 0.5 mile faster.

Several machines of the smaller sizes operated at speeds in excess of 5 miles per hour under favorable conditions in both small grain and soybeans.

In general there was no relation between size of machine and grain losses within the scope of the experiments. It was found that in combining wheat in favorable seasons cutter-bar losses for small combines were approximately the same as for the larger ones in harvesting, and the smaller machines were superior to them in threshing; in unfavorable seasons the harvesting loss with small combines was higher and the threshing loss lower than with the larger machines.

Cutter-bar losses for the small machines operating in wheat constituted 66 percent of total machine losses and in oats 21 percent of the total machine losses.

Cutter-bar losses for the 8-foot and larger machines operating in wheat constituted 51 percent of the total machine losses and in oats 25 percent of total machine losses.

Comparatively high threshing losses in oats emphasizes the importance of careful machine adjustment when threshing lightweight crops.

With soybeans in Illinois in 1935 total losses with the small and large machines were practically the same; in 1936 a lower cutter-bar loss for the larger machines resulted in a difference of over 4 percent in favor of the large machines.

In the Mississippi Delta where soybeans are planted in rows the machines in 1936 were practically as efficient as those operating in Illinois, where soybeans are drilled or broadcast.

A swath 95 percent of the total cutter-bar width was taken by the small machines in harvesting small grain while with the larger machines the swath ranged from 91 to 94 percent of the total width.

In soybeans in Illinois, the effective cutting width was 97 percent of the cutter-bar length for the small machine and 94 percent for the 8-foot or larger sizes. In the Mississippi Delta the average was 100 and 96 percent, respectively, for the small and large sizes.

Complete quality analysis of small grain samples in Illinois, 1936, indicated no effect on quality resulting from differences in size of machines.

In Ohio, 1936, with 4 of 13 samples of wheat obtained from 5- and 6-foot combines foreign material was a grading factor; with the larger machines test weight alone accounted for the discounts.

Grade analysis of soybeans in Illinois in 1935 favored the larger machines and in Mississippi the smaller machines. Different concave arrangements doubtless accounted for the difference in grades.

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